TIPS • TOOLS • TECHNIQUES

ShopNotes®

Vol. 8 Issue 47

Build Your Own Mortising Machine

- Precision Guide System Lets You Rout Perfect Mortises Every Time
- Unique Sliding Table Makes Setup Quick & Easy

- Dado Blade Storage
- Tips on Brushing a Finish
- Bench Plane Tune-Up
- No-Wrench Router Collet

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EDITOR'S NOTE

Cutoffs

I'll never forget my first stationary power tool. It was a multi-purpose tool that served as a table saw, drill press, and several other tools all rolled into one. Well I bought the tool second-hand, and to be honest, I was pretty pleased with my new purchase. Especially since several accessories had come with it.

MORTISING ATTACHMENT. One of these accessories was a mortising attachment for the drill press. It was designed to use a special *hollow chisel bit* to drill a square hole. (This is a drill bit surrounded by a square, thin-walled chisel.)

As you lowered the quill, the bit removed the bulk of the waste, and the chisel squared up the sides at the same time. At least that was the theory. In practice, it was a different story.

Using the mortising machine is a smooth, effortless process. And it cuts a crisp, clean mortise that's dead-on accurate.

I had to apply *considerable* downward pressure to get the bit to cut. Then, as it dug into the wood, the bit began to smoke, and the chisel turned blue. To make matters worse, when I raised the quill to pull the bit out of the mortise, it lifted the workpiece off the table and tore out a big splinter.

Needless to say, I was pretty frustrated with the whole thing. I went back to making mortises by drilling a series of holes with a Forstner bit then cleaning out the waste with a chisel by hand. As for the mortising attachment, it ended up on a shelf gathering dust.

That's too bad really. A mortising tool that *really* worked would be a great addition to a shop. In fact, it would be ideal for a project I'd been planning to build just recently. The project was a garden bench that required cutting over a *hundred* mortises. (That's a lot of drilling and chiseling.)

Now I suppose I could have bought a commercial mortising machine to cut these mortises. They work great. But they're expensive — $300 and up.

SHOP-MADE VERSION. So instead of buying a mortising machine, I took a "back door" approach. I challenged Ken (our project developer) to build a *shop-made version* of a mortising machine.

Not long after that, he showed up carrying an armful of parts: a long piece of aluminum channel, a couple of metal rods, and a hand crank (the kind used to tighten a pipe clamp, only larger).

At first, this odd assortment of parts had me scratching my head. But when I walked into the shop a few days later, it all started to make more sense.

The crank was attached to the top of a tall, vertical tower. Turning the crank raised and lowered a carriage that served as a platform for a router. This carriage was suspended over a sliding table that held the workpiece. By moving a handle back and forth, the table (and workpiece) slid from side to side under the router bit.

It looked like a great idea, and I couldn't wait to try it out. So I grabbed a chunk of wood, clamped it to the table, and flipped the switch on the router. As I turned the crank to lower the carriage, the tip of the bit plunged into the wood. Then, as I grasped the handle and slid the table to the side, the bit carved a crisp, clean slot in the wood.

The entire process was smooth and effortless. And the mortise was dead-on accurate. In fact, the mortising machine worked so well, we decided to feature it in this issue. In the meantime, I guess it's time to build that garden bench.

Tim

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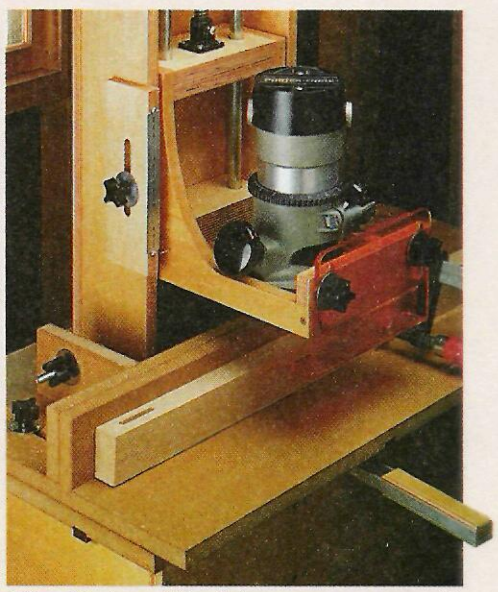

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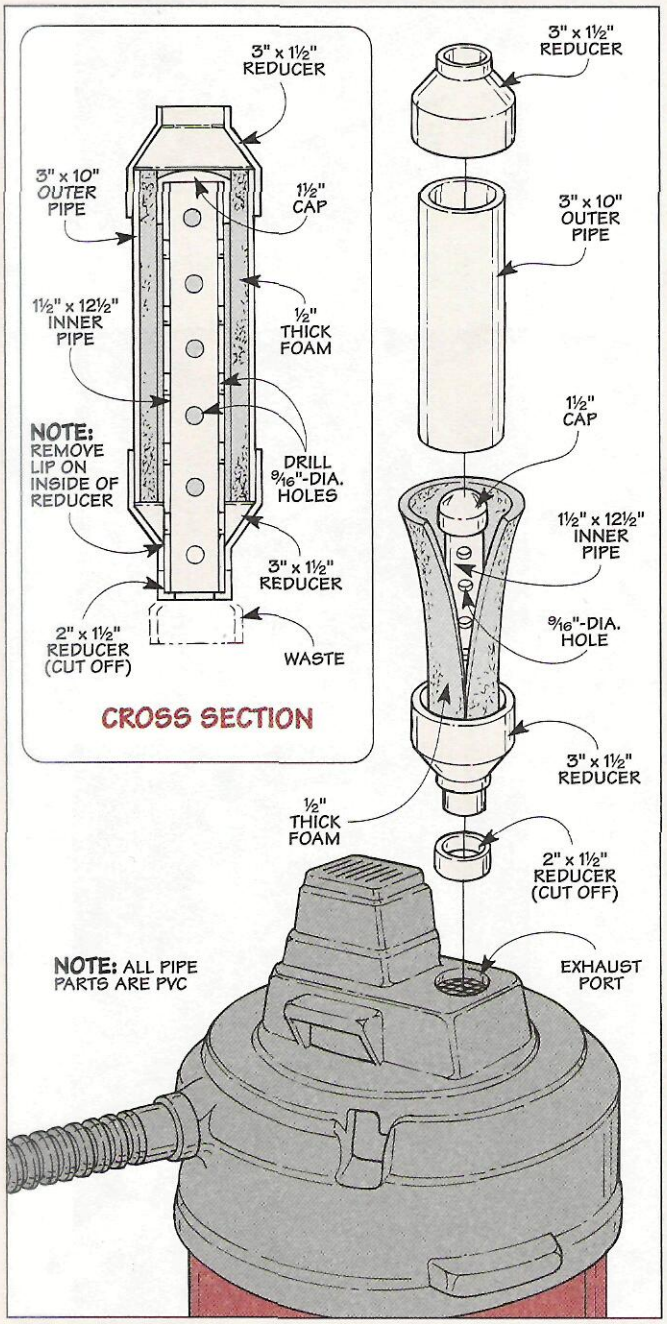
Readers' Tips

Vacuum Muffler



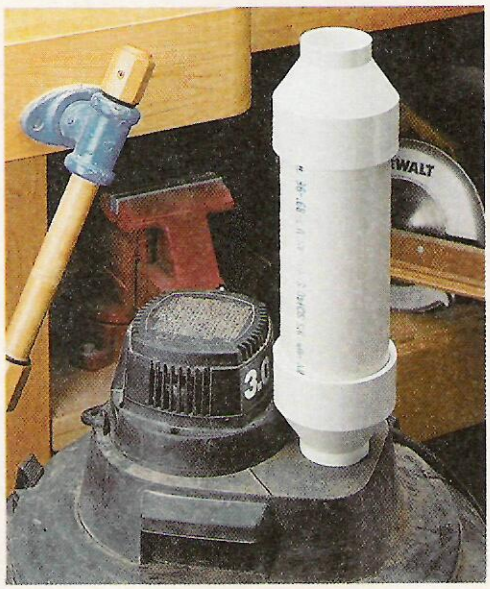
■ Shop vacuums are great tools, but they sure make a lot of noise. My dog knows. As soon as I flip the switch, he bolts out of the shop.

To reduce the noise, I made a simple muffler using inexpensive PVC pipe and pipe fittings, see photo. As it turned out, the muffler cut the noise level in half.

Editor's Note: This muffler requires the shop vacuum to have an exhaust port that allows you to attach the hose and use it as a blower.

The basic concept of this muffler is simple. Air from the vauccum is exhausted through a layer of foam that fits between an *inner* and *outer pipe*, see drawing at left. The foam dampens the sound as the air passes through. (Foam is avabilable at most upholstery shops.)

To direct air into the foam, you'll need to drill a number of holes in the inner pipe and glue a *cap* on the top end. (I used PVC cement to attach the cap.) This forces the air through the holes, into the foam, and out of a *reducer* that's glued to the top end of the outer pipe.

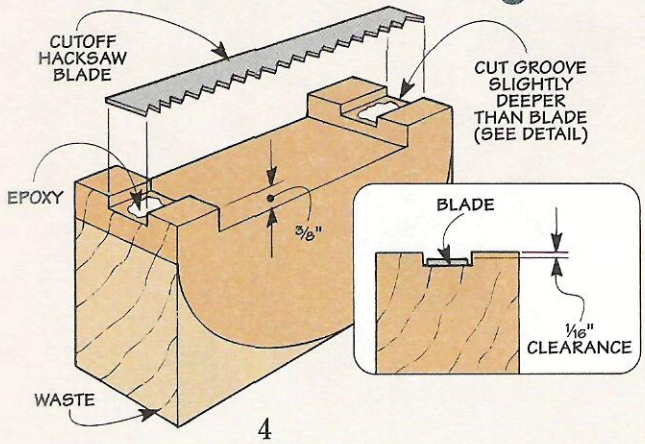


There's also a reducer on the bottom end of the muffler. But to allow the inner pipe to fit *through* this reducer, you'll need to file off the lip that's on the inside of the fitting.

To fit the muffler in the exhaust port on my shop vacuum, I added another reducer to the bottom end of the inner pipe. But first I cut off the expanded part of the reducer. Note: Don't file the lip on this reducer. It keeps the pipe from sliding through.

Chris Glowacki
West Des Moines, Iowa

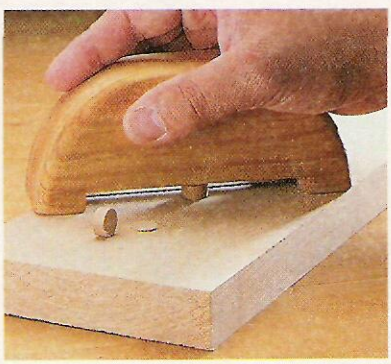
Wood Plug Trim Saw



■ Cutting wood plugs is a snap with this simple trim saw, see photo. It's just a curved wood block that holds a cutoff hacksaw blade, see drawing.

To avoid marring the workpiece, the blade is recessed in a groove, see detail. (This leaves a nub sticking up, but it's easily sanded flush.) Also, a notch provides clearance as you saw.

Chris Forgacs
North Benton, Ohio



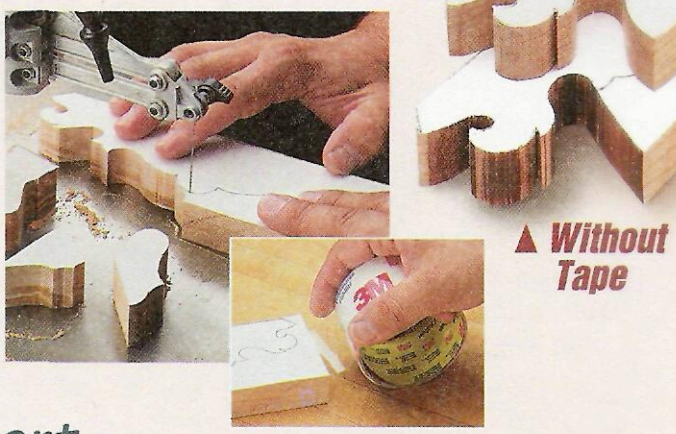
Scroll Saw Tip

■ Whenever I use a scroll saw, I find that some types of wood are just about impossible to cut without burning the edges. (Cherry seems to be the worst culprit of all.) And the problem gets progressively worse as the blade gets dull.

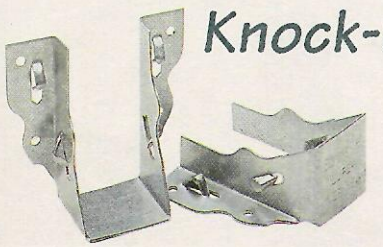
Fortunately, there's an easy solution. I just cover the cutting line with a strip of cellophane tape, see inset photo. (I use 2"-wide packing tape.) With the tape in place, it practically eliminates the burn marks on the edges, see photos in margin.

What makes the tape work? I'm not sure, but my guess is it lubricates the blade just enough to reduce the heat that's produced. As a result, I end up with a nice clean edge that requires little (if any) sanding.

Rick Hutcheson
Grimes, Iowa



Knock-Down Work Support



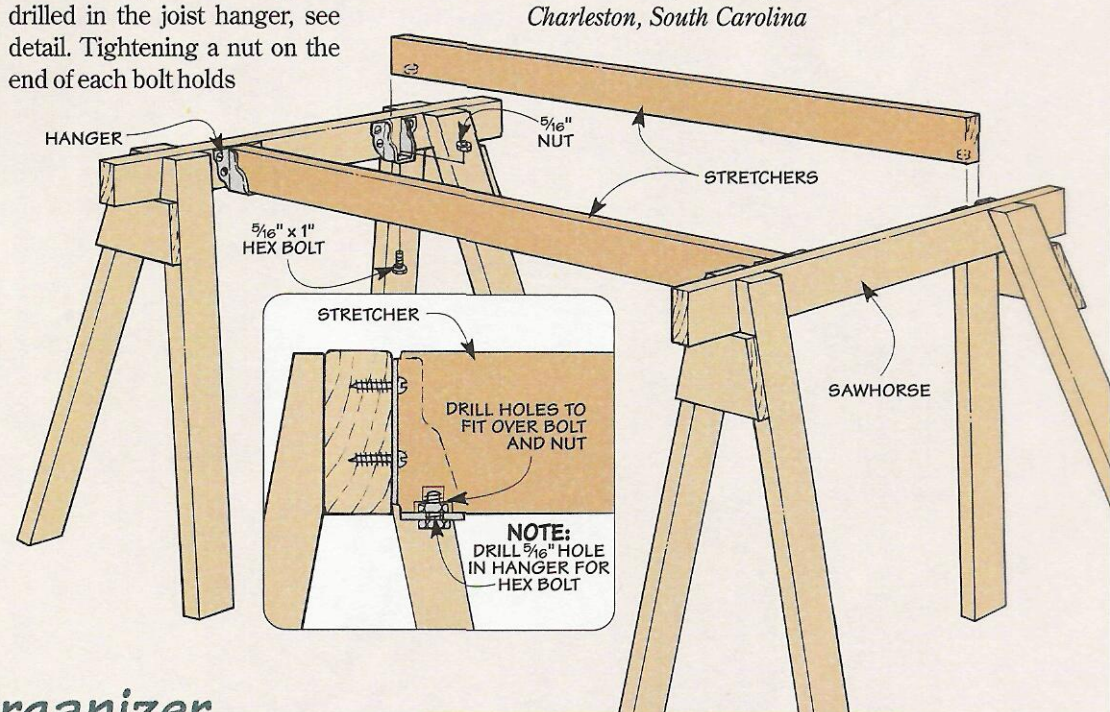
■ When cutting sheet goods or assembling a large project, an extra worksurface sure comes in handy. But I don't have room in my shop for a permanent "fixture."

So instead, I use a worksurface that "knocks down" in seconds. The key is a pair of metal joist hangers attached to each of my sawhorses, see photo above. (Joist hangers are available at most home centers.)

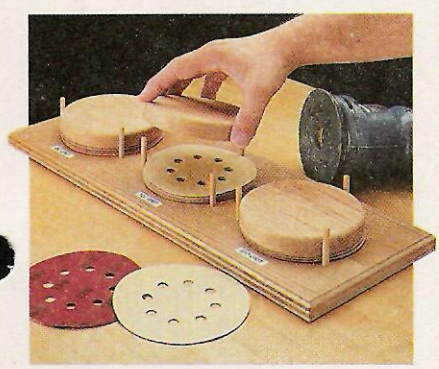
The hangers act as "pockets" that hold a couple of 2x4 stretchers, see drawing. Fitting the ends of the stretchers down into the joist hangers creates a sturdy work support.

With the stretchers in place, you don't have to worry about them accidentally slipping out of the hangers. That's because the stretchers fit onto a metal pin in each hanger that "locks" them in place. The pin is just a bolt that passes through a hole drilled in the joist hanger, see detail. Tightening a nut on the end of each bolt holds it in place. Also, you'll need to drill a counterbore near the end of each stretcher to fit over the bolt.

John Mappus
Charleston, South Carolina



Sanding Disk Organizer



■ Here's a simple way to organize the sanding disks for your random orbit sander. It's a plywood tray with three separate "bays" to hold the disks.

Each bay (one for each grit size) is formed by three dowels that surround a stack of disks. Placing a round, hardwood plate on each stack keeps the edges of the disks from curling.

Robert Page
Rochester, New York

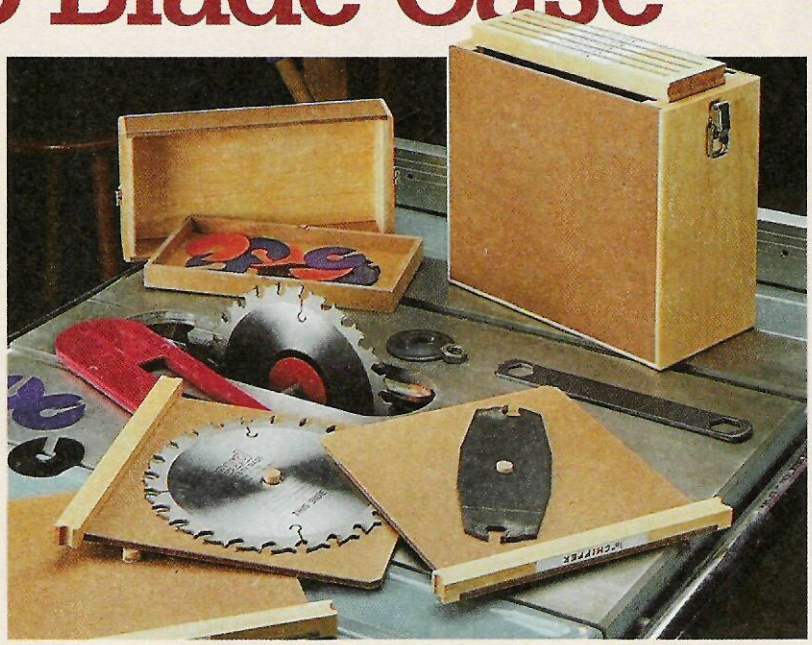
Send in Your Shop Tips

To share your original shop tips to problems you've faced, send them to: *ShopNotes*, Attn.: Readers' Tips, 2200 Grand Avenue, Des Moines, IA 50312. (Or if it's easier, FAX them to us at: 515-282-6741.)

We'll pay up to $200 depending on the published length. Please include a daytime phone number so we can call you if we have any questions.

Dado Blade Case

With a set of "hanging files," this case provides easy access to your dado blade and protects it from damage.



Until recently, I always stored my stacked dado blade set in a flat, cardboard box. The individual chippers and the two blades (the inside and outside cutters) were stacked together like a layer cake.

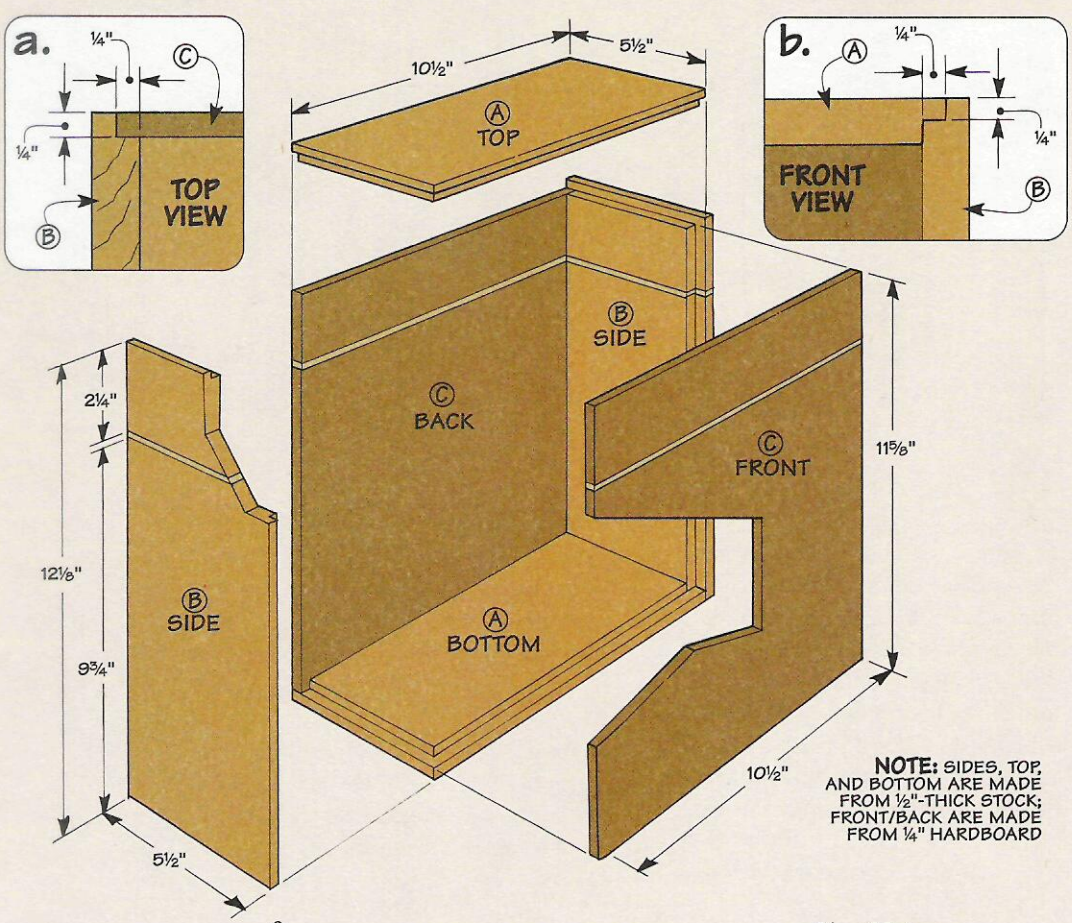
Needless to say, it wasn't much of a storage system. And it didn't help matters that I had to dig through the stack to get the right combination of chippers and blades.

The worst part of all was that with this constant shuffling of pieces, it seemed like it was only a matter of time before I'd accidentally chip one of the carbide-tipped teeth. So in order to avoid damaging the teeth (and to provide quick access to each piece in the set), I built a simple storage case, see photo above.

HANGERS. This case is designed with an individual *hanger* for each blade and chipper. (You can see the hangers lying on the saw table.) By labeling the individual hangers, I can see at a glance which chipper (or blade) I need.

STORAGE TRAY. There's one more thing I especially like about this storage case. To hold the shims for my dado blade, there's a "secret" storage tray that fits inside the lid, see photo on page 9.

Design Note: This storage case is designed to hold an 8" dado blade with six chippers and two blades. For a smaller blade (or if there are fewer pieces), you may want to modify the overall size of the box.



THE CASE

The case consists of two parts: a tall *box* that holds the hangers and a short *lid* that fits down around them. But I didn't build these parts separately. It's easiest to make a single, enclosed case first and then cut it apart to form the box and the lid.

ENCLOSED CASE. There's nothing complicated about building the enclosed case. The *top/bottom (A)* and *sides (B)* are pieces of ½"-thick hardwood (maple) that are assembled with simple rabbet joints, see drawing at left. This requires rabbeting the narrow ends of each piece, see detail 'b.' You'll also need to rabbet the long edges to accept a ¼" hardboard *front* and *back (C)* piece, see detail 'a.'

GLUE-UP. With the joinery complete, you're ready to glue and clamp the case together. One thing to

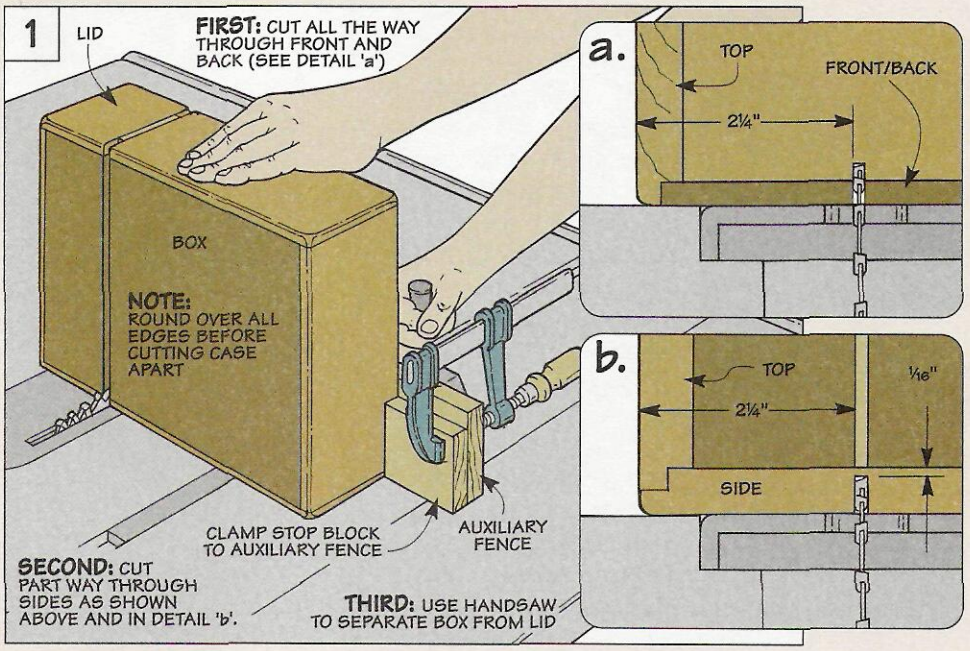
watch here is that you don't apply too much glue. Since any glue squeeze out in the bottom corners of the box will be difficult to clean up, a thin film is all that's needed.

ROUND EDGES. After the glue dries, it's a good idea to "ease" the sharp outside corners of the case. This is just a matter of mounting a round-over bit in a table-mounted router and routing around all the outside edges of the case.

CUT CASE APART. Now it's time to cut the case apart to form the lid and the box. A table saw and a miter gauge make quick work of this, see Fig. 1. But the head of the miter gauge is too small to provide much support for the case. So I attached a long fence for extra support. Also, clamping a stop block to the fence will prevent the case from shifting and keep all four cuts aligned.

Start by raising the saw blade to cut *through* the thickness of the front and back, see Fig. 1a. Then with the case held firmly against the fence and stop block, cut through the front and back only.

Before cutting the sides of the case, lower the blade so it leaves a thin (1/16") membrane, see Fig. 1b. This will keep the case intact and prevent it from "pinching" the saw blade. After cutting both sides, I used a hand saw to separate the lid and sanded the edges smooth.



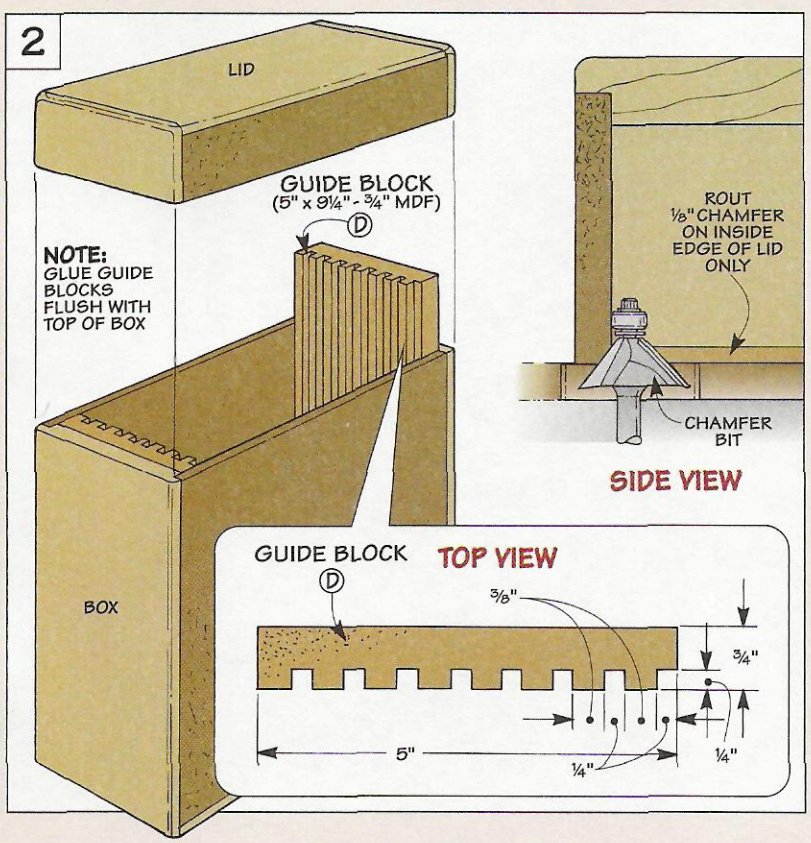
GUIDE BLOCKS. At this point, I set the lid aside and added two *guide blocks (D)* to the box, see Fig. 2. These are just pieces of 3/4" MDF with a number of grooves that guide the hangers in and out of the box.

One thing that's a bit unusual here is that the first groove is formed by *rabbeting* one edge of each guide, see Top View in Fig. 2. To cut this rabbet, I mounted the dado blade in the table saw and "buried" part of it in an auxiliary fence clamped to the rip fence.

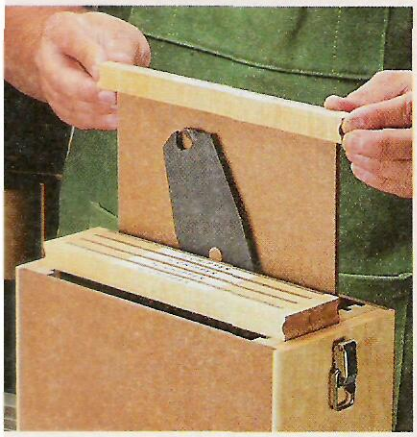
Each of the remaining grooves is made by making successive passes on the table saw, adjusting the position of the fence between each pass.

ATTACH GUIDE BLOCKS. Once the grooves are completed, the guide blocks are simply glued to the sides of the box, see Fig. 2. Clamping the top of the guide blocks isn't a problem. But the jaws on my clamps didn't have enough "reach" to hold the bottom ends. So I cut a scrap and wedged it between the guide blocks to "clamp" them in place.

CHAMFER LID. As you're waiting for the glue to dry, there's one last thing to do. That's to mount a chamfer bit in the router table and rout the bottom inside edge of the lid, see Side View in Fig. 2. It's just a small (1/8") chamfer. But it makes a big difference in how easy it will be to fit the lid down over the hangers.



Hangers

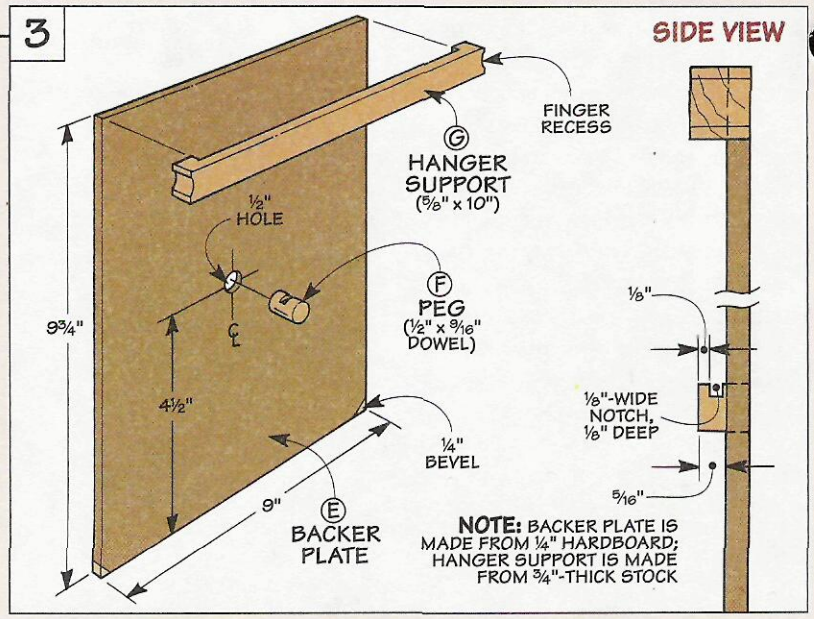


One of the handiest things about this storage case is a set of hangers that hold the individual blades and chippers. The hangers are like the hanging folders in a filing cabinet. You just lift them out of the case to get the blades or chippers you want, see photo.

Each hanger consists of three pieces: a *backer plate* to keep the blades and chippers separated, a *peg* to hang them on, and a *hanger support* that doubles as a handle, see Fig. 3. (Altogether I made eight hangers.)

BACKER PLATE. The *backer plate (E)* on each hanger is a piece of ¼" hardboard with a hole drilled in it to accept the peg. To slip the hanger into the case without "catching" the guide blocks, I trimmed the bottom corners of each plate at an angle.

PEG. The next step is to add the *peg (F)* to each backer plate, see Fig. 3. It's just a dowel with a shallow notch in it, see Side View in Fig. 3. When you hang a blade (or chipper) on the peg, it fits down into the notch. This holds the blade securely against the backer plate.



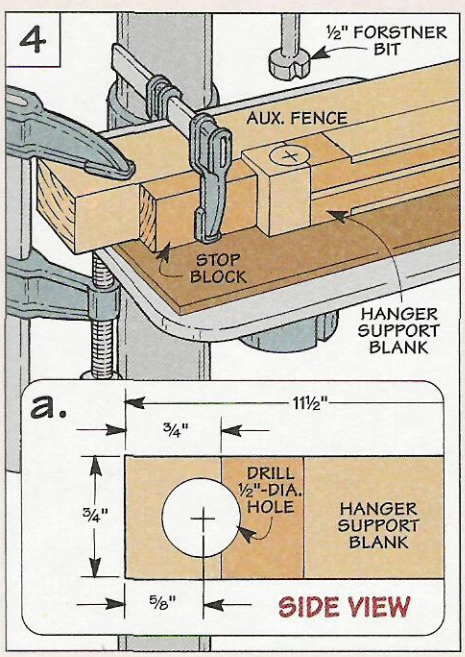
HANGER SUPPORTS. All that's left is to add *hanger supports (G)* to the backer plates, see Fig. 3. These are just narrow strips of hardwood that rest on top of the guide blocks in the box. A finger recess on the ends of each hanger support makes it easy to pull the hanger out of the case.

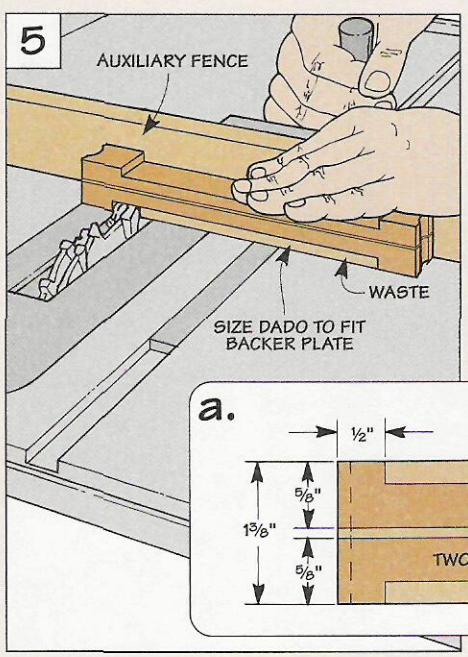
To make the hanger supports, I started out with four blanks of ¾"-thick stock. These blanks are oversized in length (11½") and width (1⅜"), see Figs. 4a and 5a. This way, I was able to make two hanger supports from each blank.

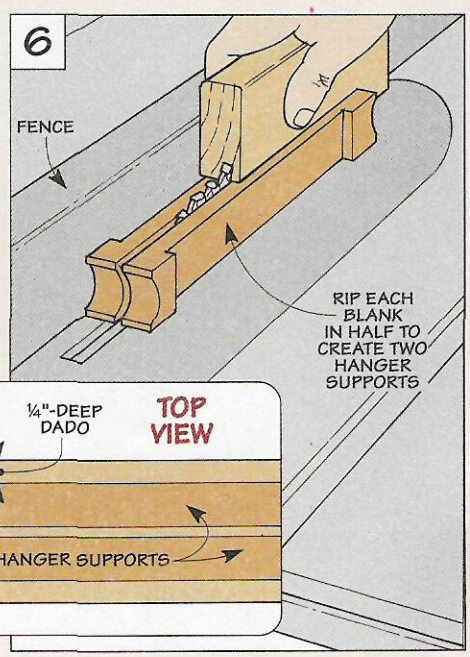
FINGER RECESSES. To form the finger recesses, I used a simple two-step process. First, drill a hole near both ends in each of the blanks, see Figs. 4 and 4a. Then, to create the recess, cut through the hole as you trim the waste from each end.

CUT DADOES. The next step is to cut a pair of long, shallow dadoes in each blank to fit the backer plates, see Figs. 5 and 5a.

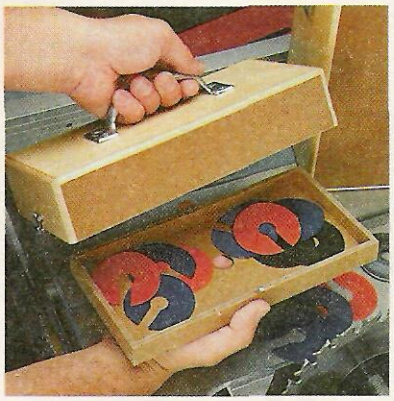
RIP BLANKS. To complete the hanger supports, simply rip each blank in half, see Fig. 6. Then glue the supports in place.





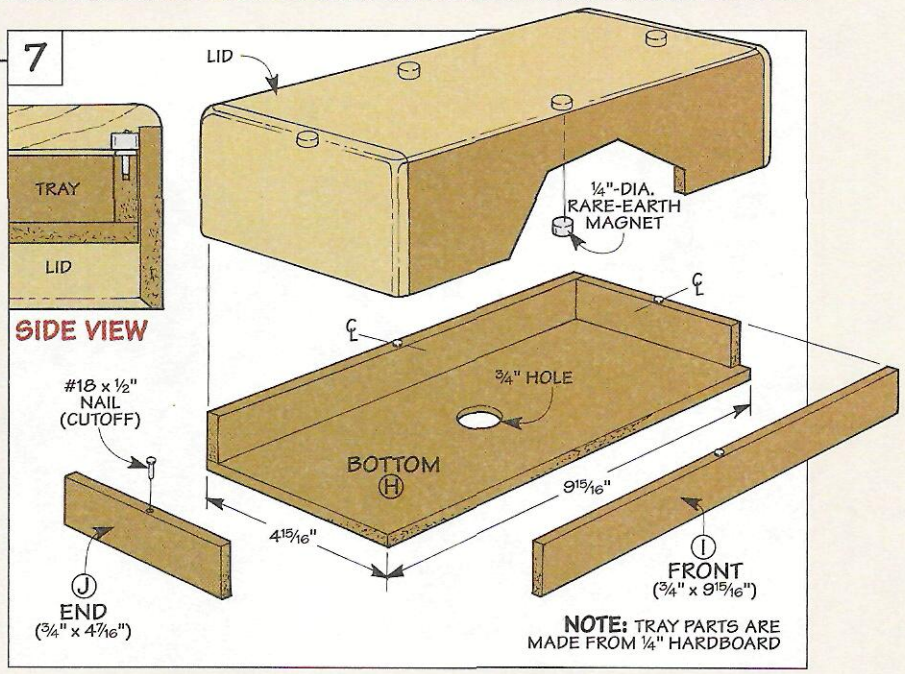


Storage Tray

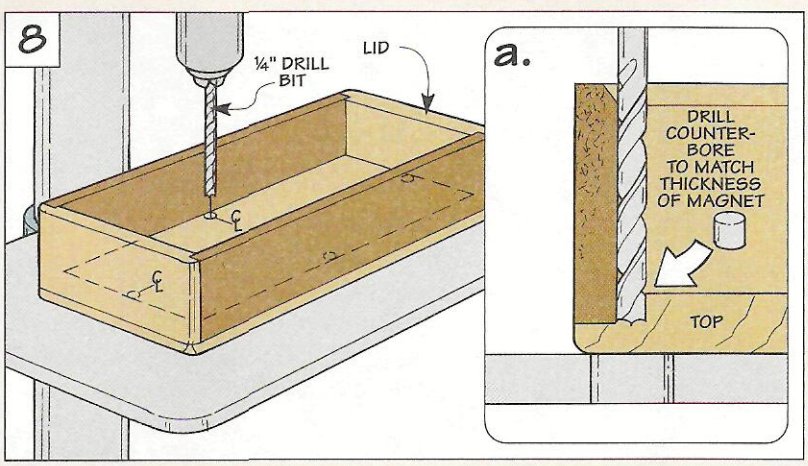


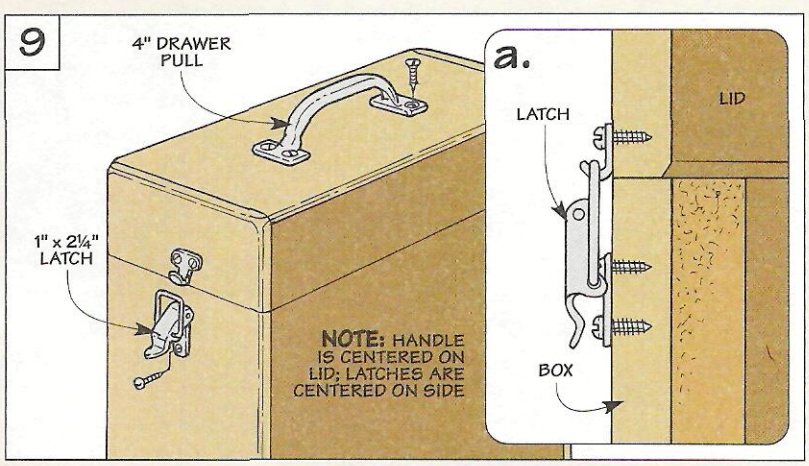
Besides making the case to hold my dado blade, I also wanted to keep track of the shims used to adjust the width of the blade. So I made a shallow tray that holds the shims and fits up inside the lid of the case, see photo above.

It's hard to imagine a simpler tray. Basically, it's just a few pieces of ¼" hardboard that are assembled with butt joints, see Fig. 7.



TRAY BOTTOM. The *bottom (H)* of the tray is sized to fit into the lid so there's 1/32" gap all the way around. Drilling a centered finger hole lets you pull the tray out of the lid.





Now it's just a matter of ripping several narrow strips to make the *front/back (I)* and *ends (J)* of the tray. Gluing these strips in place is all that's needed to hold the tray together.

MAGNETS. The tray is held in place with four small magnets embedded in the lid. These magnets contact nails installed in the top edge of the tray, see Side View in Fig. 7. So when you slip the tray into the lid, it just "clicks" into place.

To keep the tray from falling out, I used a special type of magnet called a *rare earth magnet*. These magnets are quite strong. Even the small (¼"-dia.) ones I used have an amazing amount of holding power. (For sources of magnets, see page 31.)

The magnets fit in holes drilled inside the lid. To contact the nails in the tray, you'll need to drill these holes right next to the sides of the lid, see Figs. 8 and 8a. A bit of epoxy secures the magnets in the holes.

INSTALL NAILS. With the magnets in place, you can drill the holes in the tray for the nails. Here again, I used epoxy to hold the nails in the tray.

HANDLE & LATCHES. All that's left to do is add a handle to the lid and a pair of latches to the sides. The handle (I used a drawer pull) and latches are simply screwed in place, see Figs. 9 and 9a.

Restoring a Bench Plane

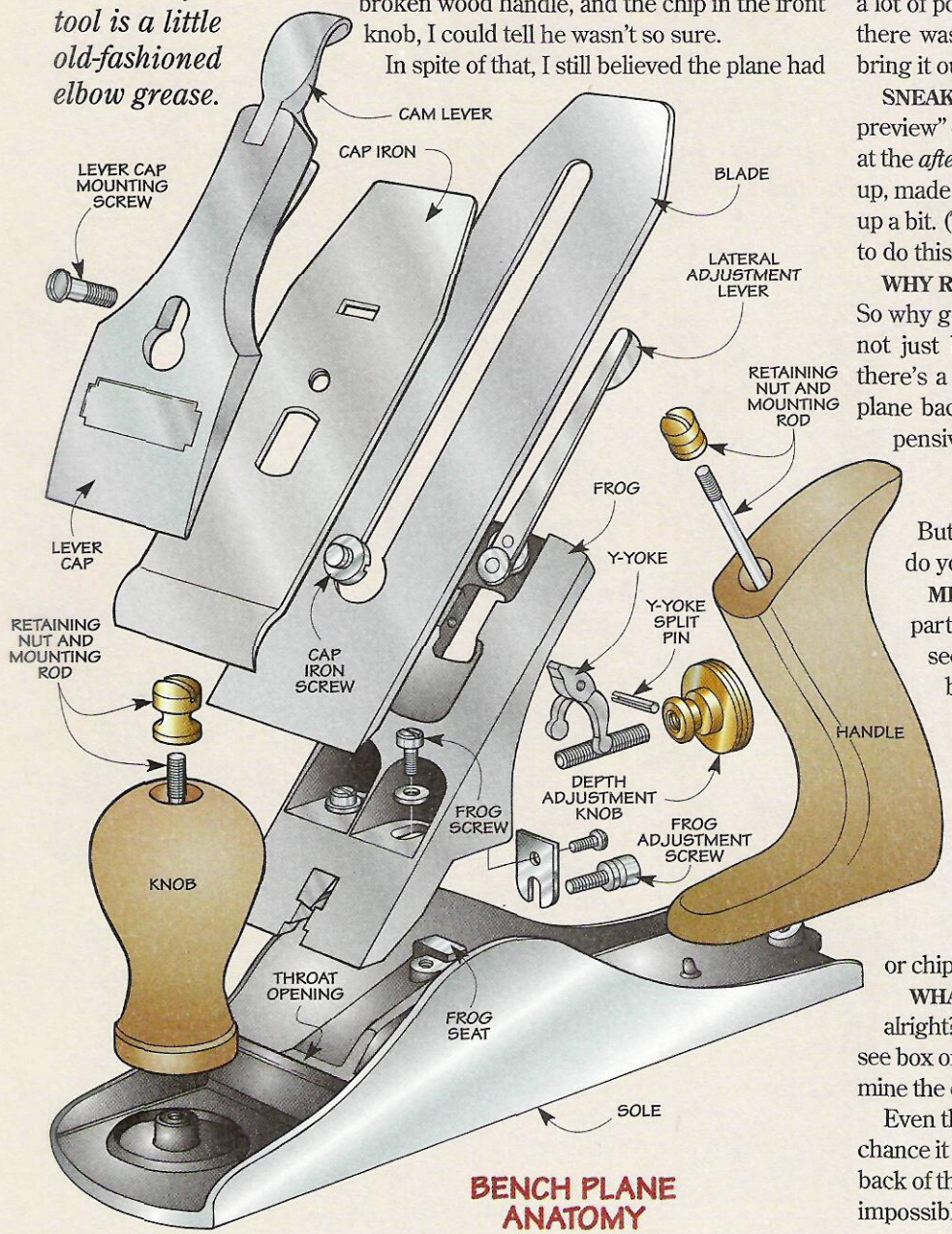
All it takes to transform a neglected plane into a useful tool is a little old-fashioned elbow grease.

For twelve bucks, you can't go wrong. That's what I told a friend of mine as I showed him the old, rusty bench plane I'd bought at an auction. (It's the plane in the *before* photo above.) But as he surveyed the black, gritty metal, the broken wood handle, and the chip in the front knob, I could tell he wasn't so sure.

In spite of that, I still believed the plane had a lot of potential. Somewhere under that rough exterior, there was a precision hand tool. And all it required to bring it out was a little elbow grease and some patience.

SNEAK PREVIEW. By the way, if you'd like a "sneak preview" of how the plane actually turned out, take a look at the *after* photo. It's the same plane. Only I've cleaned it up, made a new handle and front knob, and then tuned it up a bit. (The next few pages are devoted to the methods to do this, so I won't go into them here.)

WHY RESTORE? Okay, but it sounds like a lot of work. So why go to the trouble of restoring an *old* plane? Why not just buy a *new* plane? Two reasons. First of all, there's a lot of satisfaction in turning an old neglected plane back into a useful tool. And second, it's an inexpensive way to acquire a quality hand tool.



BENCH PLANE ANATOMY

WHAT TO LOOK FOR

But not *every* old plane is worth restoring. So how do you know just what to look for?

MISSING PARTS. First of all, check to see if any parts are missing. I like to account for each piece, see drawing. But if one is missing, it is possible to buy replacement parts, see Sources on page 31. Just a word of caution. Depending on the parts you need, the cost can add up quickly.

CHECK FOR DAMAGE. Another thing to check is whether any parts are *damaged*. Some damage (like the handle and front knob on my plane) is easy to repair. Other things are more difficult (or impossible) to fix. For example, I'd steer clear of planes with cracked or chipped castings, bent blades, or heavy rust.

WHAT ABOUT RUST? So just how much rust is alright? If it's just a light surface rust, it's easy to remove, see box on page 11. The problem is you can't always determine the extent of the rust. I found out the hard way.

Even though the blade on my plane was rusty, I took a chance it might be salvageable. I was wrong. Sanding the back of the blade exposed deep rust pockets that made it impossible to get a sharp edge, see margin on next page.

My solution was to buy a replacement blade. That added $12.50 to the overall cost of the plane. But it was still considerably less expensive than buying a new plane.

DISASSEMBLY & CLEANING

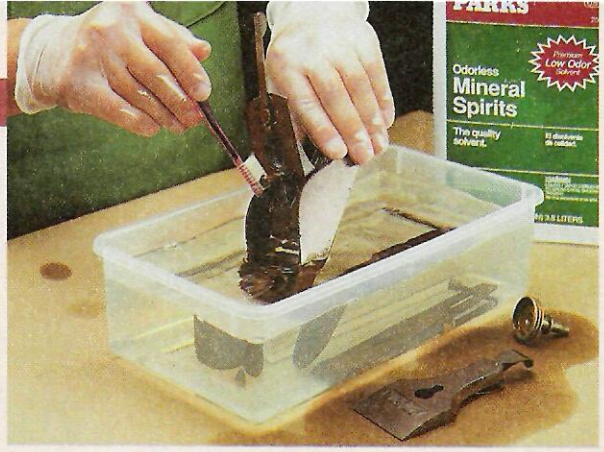
Except for the blade, the rest of the plane was in good shape. Granted, it was covered with black, oily gunk. But it wasn't anything that couldn't be fixed by taking the plane apart and cleaning all the individual pieces.

CAM LEVER & BLADE ASSEMBLY. I started by popping the *cam lever* up and removing the *lever cap* that secures the blade assembly, see drawing on page 10. The *cap iron* and *blade* lifted out easily after that.

FROG. Removing the blade assembly gave me a good look at the *frog*. Okay, I know. It's a funny sounding name. But the frog has an important job. It provides a mounting platform that holds the blade at an angle. It also lets you adjust the size of the throat opening.

The two screws that are loosened to make this adjustment sit in pockets in the sloped face of the frog. (If you look at the disassembled plane below, you can see spider webs in the pockets where spiders had made a home.)

BLADE ADJUSTMENTS. At the top end of the frog, the *lateral adjustment lever* that aligns the cutting edge of the blade was sticky with grime, so it didn't move back and forth very easily. And the *depth adjustment knob* that raises and lowers the blade was so dirty it was hard to budge.



▲ *Mineral Spirits Bath. To loosen rust and grime, soak the metal parts of the plane in mineral spirits. Then scrub each part clean with a brush and set it aside to dry.*

BODY. Not surprisingly, when I removed the screws that hold the frog in place, it was "frozen" to the *body* of the plane. Rust had gotten a foothold here as well. To loosen the frog, I decided to remove the *handle* and *front knob* and give the plane a bath.

BATH. This was just a matter of soaking the plane (and the disassembled parts) in a plastic tub filled with mineral spirits, see photo above. It only took about a half hour for the mineral spirits to soften years of accumulated dirt and grease. After scrubbing the plane with a toothbrush, I gently tapped the frog loose, wiped each part off with a rag, and set them aside to dry.

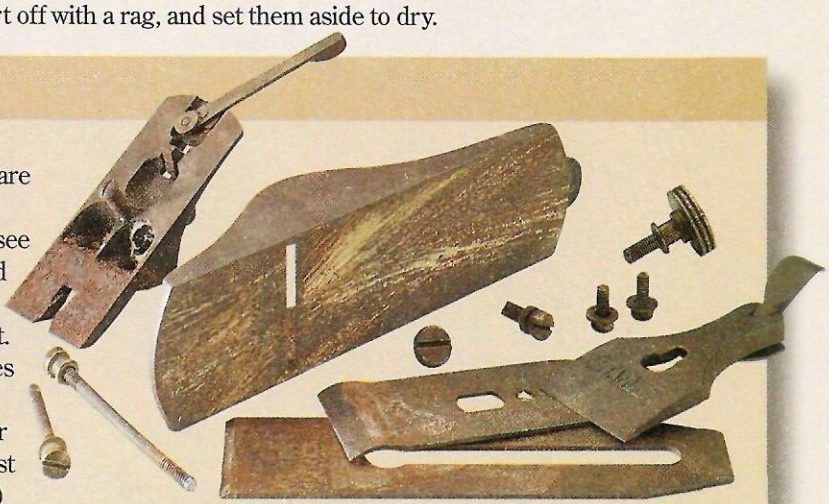
▲ *Heavy pitting on the back side of the blade made it impossible to get a sharp cutting edge.*

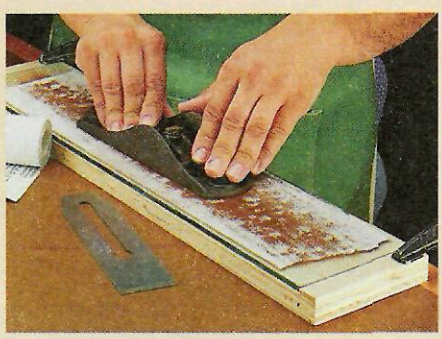
Dealing with Rust

There's nothing exciting about removing rust. But there are things you can do to make the job easier.

SAND. One of the simplest ways is to *sand* off the rust, see photo A. Besides the rust, the sole of my plane was streaked with white paint (probably from planing storm windows). But scrubbing it across 100-grit sandpaper cleaned it up fast.

WIRE WHEEL & ERASER BLOCKS. But not all the surfaces are flat. To get into hard to reach places, using a wire wheel on the grinder was just the ticket, see photo B. Also, a rubber block embedded with silicon carbide made a handy rust "eraser," see photo C. (See page 31 for a mail-order source.)





A. Sandpaper. To remove rust from the sole, I "scrubbed" the plane across sandpaper attached to a piece of glass.

B. Wire Wheel. Using a wire wheel on a grinder makes quick work of removing rust in hard to reach areas.

C. Eraser Blocks. These rubber blocks embedded with silicon carbide work great for "erasing" rust from metal parts.

▲ *All it takes to make a new handle for your plane is a scrap block of wood and a few simple steps.*

Making a Handle

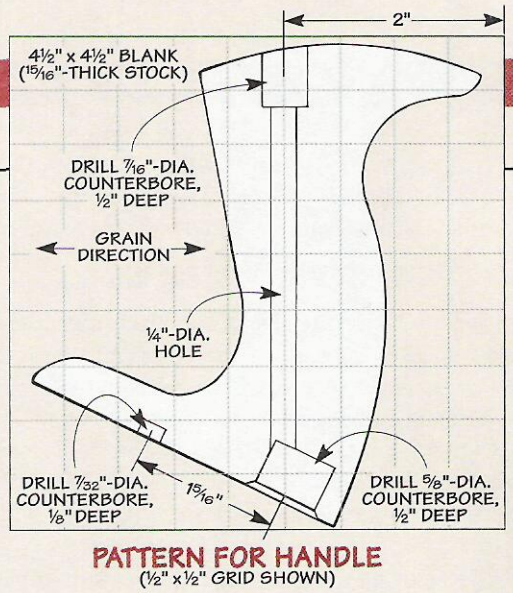
My bench plane wasn't much different than a lot of old planes I've seen — the curved tip on the upper part of the handle was broken. So I made a new one from a block of mahogany I'd been saving, see photo.

PATTERN. Before getting started, I found it helpful to make a pattern. Attaching the pattern to the block will make it easy to cut the handle to shape later, see Step 1 below. But it also helps orient the block when drilling holes for the mounting rod and nut that holds the handle in place, see Steps 2 and 3.

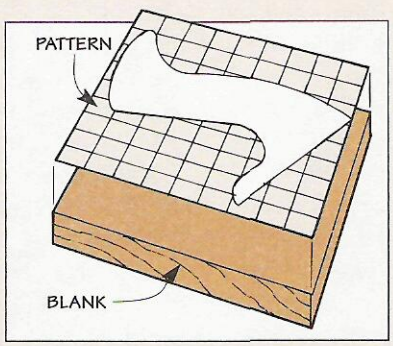
TRIM BLOCK. But you can't drill all the holes just yet. To get the handle to sit flat on the metal body of the plane, you'll need to first trim the block at an angle, see Step 4. Save the wedge that's trimmed off. It makes a handy support when drilling the holes in the base of the handle, see Step 5.

SHAPE HANDLE. Now it's just a matter of cutting the handle to shape (Step 6) and using a rasp to create a comfortable grip, see Step 7.

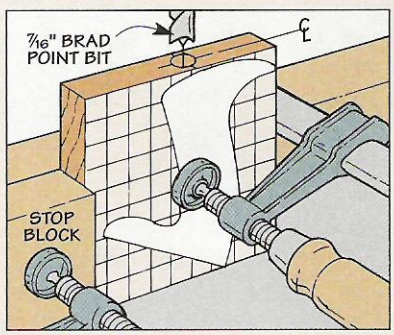
FINAL DETAILS. After applying a dye stain to the handle (see margin on page 13), I sprayed on four coats of *Deft* spray lacquer and installed the handle, see Step 8.



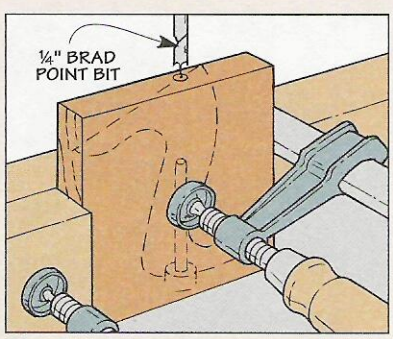
PATTERN FOR HANDLE
(½" x ½" GRID SHOWN)



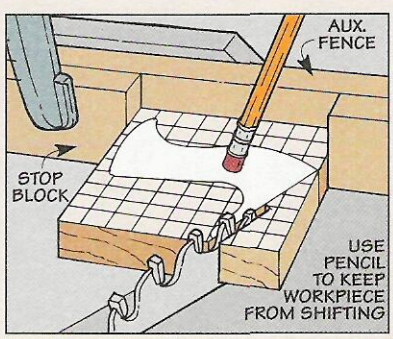
1 *Align the bottom of the pattern with the edge of the blank and attach it with spray adhesive.*



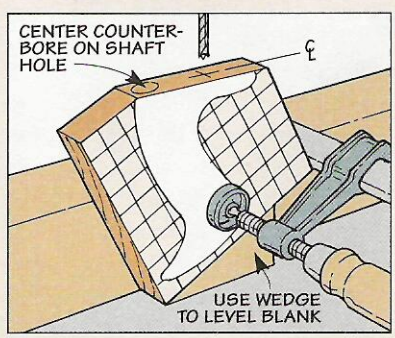
2 *Now drill a counterbored shank hole to accept a retaining nut and mounting rod for the handle.*



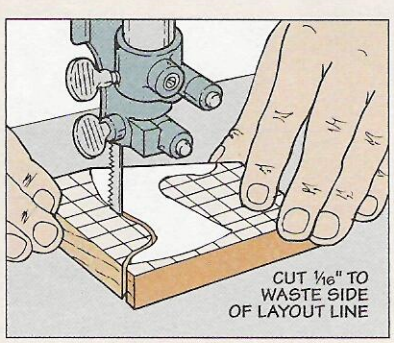
3 *To complete the shank hole, flip the workpiece around and then drill the rest of the way through.*



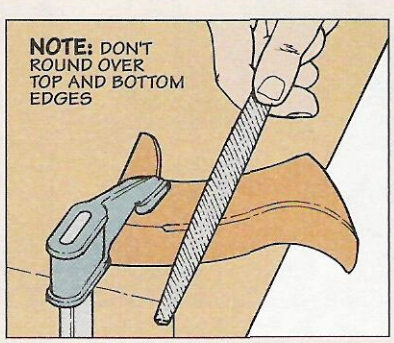
4 *Trimming a wedge off the corner of the workpiece establishes the base of the handle.*



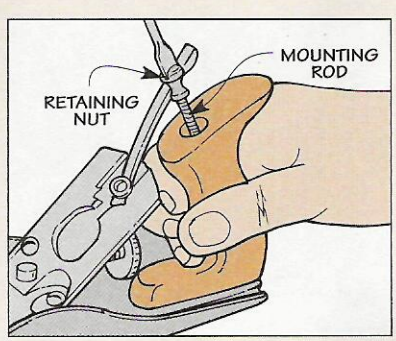
5 *Using the wedge as a support, drill two holes to fit the base of the handle on the body of the plane.*



6 *With all the holes completed, a band saw makes quick work of cutting the handle to rough shape.*



7 *To provide a comfortable grip, round the edges with a rasp and sand the handle smooth.*



8 *After applying a dye stain and finish, secure the handle with the mounting rod and nut.*

Turning a Knob

▲ *Making a new front knob to replace a damaged one is easy. Just turn a scrap block to shape on the lathe.*

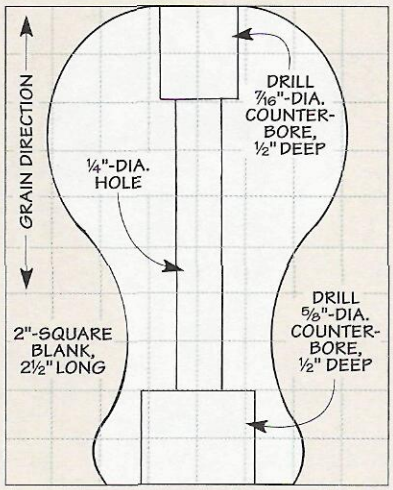
Although the front knob on my plane was still usable, there was a chip at the base that looked like a kid missing a front tooth. So I decided to turn a new knob on the lathe.

TURNING BLANK. Once again, digging through my scrap pieces turned up an ideal turning blank. And I cut it to length to match the height of the knob, squaring up the ends in the process.

DRILL HOLES. To fit the knob over the metal boss on the body of the plane, there's a counterbore in the end of the blank, see Step 1.

Later, after the knob is turned to shape, the centerpoint of this hole becomes important. It has to align with a hole that accepts a mounting rod for the knob. But there's a catch.

If you drill the hole for the rod now, you can't mount the blank on the lathe. (It's too large to fit on the tailstock without wobbling.)



PATTERN FOR KNOB
(1/4" x 1/4" GRID SHOWN)

MOUNT BLANK. The solution is to drill a small (1/8") pilot hole that fits in the tailstock, see Step 2. That takes care of one end of the blank. But to secure the opposite end, I used a simple trick.

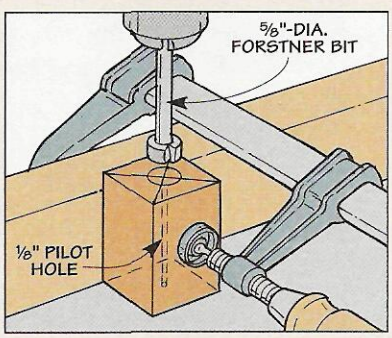
The idea is to screw a scrap block to a faceplate, see detail 'a' in Step 2. Then, after mounting the faceplate to the lathe, turn a short tenon in the scrap. The goal is to get the tenon to fit snug in the counterbore on the end of the blank.

TURN KNOB TO SHAPE. Once the blank is securely mounted on the lathe, it's just a matter of turning the knob to shape, see Step 3 and the pattern at left.

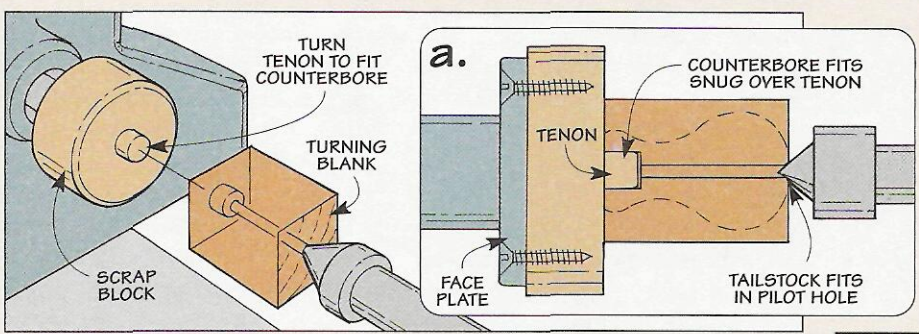
MOUNTING HOLES. After sanding the knob smooth, the next step is to drill a counterbored shank hole to accept the mounting rod. (This is the hole I mentioned earlier — the one that needs to align with the counterbore in the bottom of the knob.)

An easy way to accomplish this is to clamp a scrap to the drill press and drill a hole to match the size of the counterbore. Then fit a dowel in the hole to use as a centering pin. Setting the knob over the dowel ensures proper alignment as you drill the holes, see Step 4.

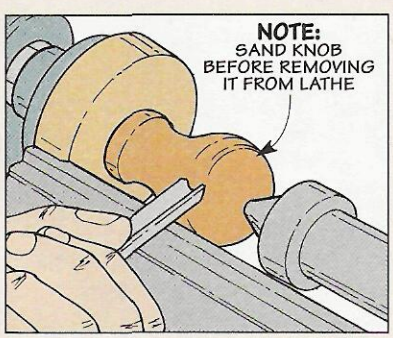
INSTALL KNOB. Now it's just a matter of applying a dye stain (and finish) and installing the knob, see Step 5.



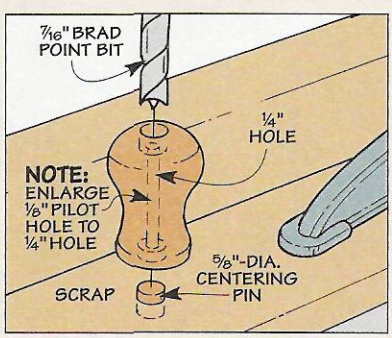
1 *To make the front knob, start by drilling a counterbore and an 1/8" pilot hole in the turning blank.*



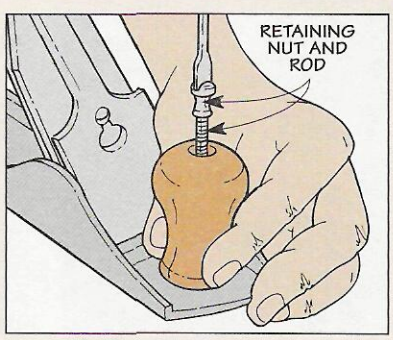
2 *After attaching a scrap block to a faceplate, turn a tenon to fit the counterbore in the bottom of the blank. Then slide the tailstock forward so the centerpoint fits in the pilot hole and lock it in place.*



3 *Using the pattern of the knob as a guide, turn the blank to final shape with a spindle gouge.*



4 *Using a dowel as a centering pin, drill a counterbored shank hole for the nut and mounting rod.*



5 *Now just use the retaining nut and mounting rod to secure the front knob to the body of the plane.*

▲ *Brushing on an aniline dye (Cuban red mahogany) creates a traditional dark-colored handle.*

Bench Plane Tune-Up

If you're restoring an old bench plane, chances are it's in need of a tune-up. But that's also true for a brand new plane right out of the box. Either way, a simple tune-up will turn a bench plane into a precision tool.

SHARPEN THE BLADE

The best way to end up with good results is to start with a sharp blade.

THE EDGE. The cutting edge of the blade is formed by the intersection of two surfaces — the *back* and the *bevel* of the blade. To get a sharp edge, you want these surfaces smooth and flat.

FLATTEN BACK. When flattening the back, I "sand" it on a flat surface like a piece of glass, see Step 1 above. Start with 220-grit silicon-carbide sandpaper and sand until there's a consistent set of scratch marks. Then polish the back using progressively finer grits. (I work up from 400 to 2000-grit).

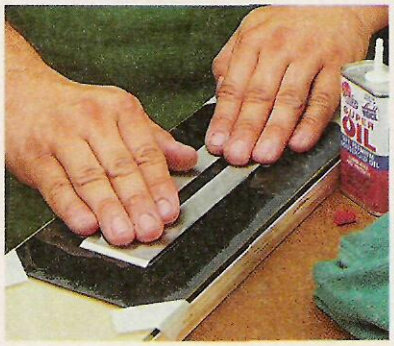
This takes some elbow grease. But the nice thing is you only have to do it one time. Once the back is flat, you just need to concentrate on the bevel the next time you sharpen the blade.

NOW THE BEVEL. Now it's just a matter of making the bevel as flat and smooth as the back. The secret is to hold the blade at a consistent angle. To do this, I use a honing guide, see Step 2. Basically, this is a rolling clamp that holds the blade at the desired angle.

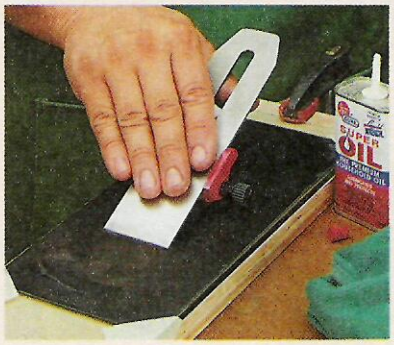
Here again, the idea is to proceed from a coarse to a fine grit. The trick is knowing where to start. This requires matching the grit to the condition of the bevel. If there's a nick in the edge, I start with 180-grit sandpaper. But this is too coarse for most work. For example, 220-grit sandpaper is fine for a new blade. If you're just touching up an edge, you may want to start with 800-grit.

EVEN PRESSURE. Regardless of the grit, the key is to apply pressure *evenly* across the blade. The only exception is if the blade is out of square. In that case, apply a little extra pressure on the "high" corner to square the blade as you sharpen.

Sharpening the Blade



1 *Using oil as a lubricant, sand the back of the blade across a piece of silicon-carbide sandpaper.*



2 *A honing guide ensures that the blade remains at a consistent angle while you're sharpening.*

BURR. As you work with each grit, a burr will start to form on the back of the blade. You can't see it, but you can *feel* the burr by running your finger up the back of the blade. When you get a nice even burr across the entire width of the blade, remove it by alternately sanding the back and bevel with the final grit of sandpaper used to polish the back.

FITTING THE CAP IRON

It takes more than a sharp blade to plane a surface smooth. The cap iron that's attached to the blade also needs some attention.

The purpose of the cap iron is simple. To prevent tearout, it "breaks" the shaving as the blade slices through the wood. To do this, the nose of the cap iron is curved.

SAND EDGE. The problem is that if the edge of the cap iron doesn't sit flat against the blade, the shavings can wedge under the cap iron. This can create a "log jam" of shavings, making it difficult to plane a surface smooth. To prevent this, the curved edge of the cap iron needs to be sanded smooth and even, see Step 1 at left. Here again, I use 220-grit silicon-carbide sandpaper.

POSITION CAP IRON. Once the edge is sanded smooth, it's important to position the cap iron properly. In general, I attach the cap iron so it's about $1/16$" from the front edge of the blade. But for fine work, when I want paper-thin shavings, I set it about $1/32$" from the front edge.

Fitting the Cap Iron

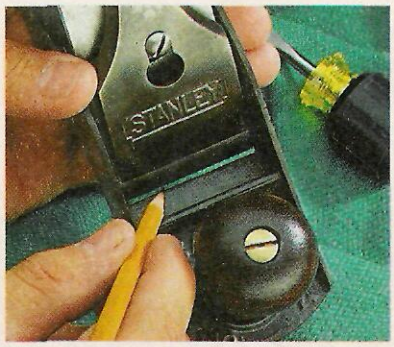
1 *Lower the back end of the cap iron slightly, then sand the front edge by making a few smooth strokes.*

2 *After smoothing the edge of the cap iron, tighten it in place just behind the leading edge of the blade.*

Adjusting the Frog

1 *To adjust the opening of the throat, start by loosening the screws that hold the frog in place.*

2 *Then turn the screw at the back of the frog to adjust the size of the throat opening.*



3 *To check the size of the throat opening, tighten the frog down and then reinstall the blade.*

ADJUSTING THE FROG

With the cap iron in place on the blade, you're almost ready to start planing. But first you'll need to adjust the throat opening where the blade projects through the bottom of the plane.

The goal here is to size the opening so it "matches" the position of the cap iron on the blade. This way, they both work together to create nice even shavings.

ADJUST FROG. To do this, you'll need to adjust the position of the frog. Start by loosening the screws on the top of the frog, see Step 1 above. Then turn the adjustment screw at the back of the frog to adjust the opening, see Step 2. After reinstalling the blade, check the size of the opening, see Step 3. Note: Tighten down the frog before reinstalling the blade.

So how do you know that the frog is adjusted just right? Basically, it's a trial and error process.

As a rule, start by adjusting the opening so it's about *twice* the setting of the cap iron. For example, for fine work, I'll open the mouth to $1/16$" (twice the cap iron distance of $1/32$").

Then after reinstalling the blade, check the setting by planing the edge of a scrap. The shavings should come off the workpiece smoothly and evenly without jamming in the opening of the mouth.

FLATTENING THE SOLE

There's one last thing to consider when tuning up a plane — the flatness of the sole.

If there's a slight bump in the sole, it will prevent the cutting edge of the blade from making full contact with the workpiece. And if the sole is dished out, it's almost impossible to plane a surface flat.

REFERENCE SURFACE. To check whether the sole is flat or not, you need a flat reference surface. Here again, a piece of glass works fine.

To check the sole, draw lines across it with a marker, see Step 1 below. Then sand the plane across a piece of silicon-carbide sandpaper, see Step 2. After a few strokes, check your progress. Any low spots will show up as dark lines, see Step 3.

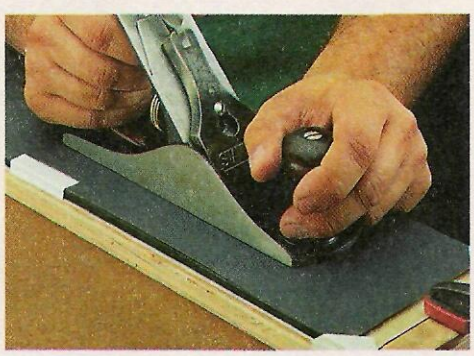
Note: Be sure to sand the plane with the blade in place (and retracted). This will "stress" the body of the plane like it is in use.

The idea is to continue sanding until the lines disappear. Then polish the sole on progressively finer grits of sandpaper (up to 400-grit).

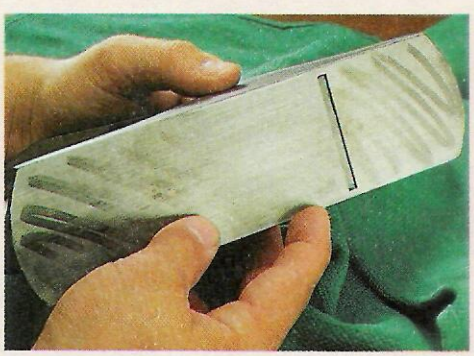
Finally, give the metal surfaces a coat of paraffin wax. Unlike a machine oil, the wax will protect the plane without leaving a residue on the workpiece that can ruin a finish.

Flattening the Sole

1 *To flatten the sole, start by drawing squiggly lines across the sole of the plane with a permanent marker.*



2 *Then "scrub" the plane back and forth on a sheet of 220-grit silicon-carbide paper that's taped to a piece of glass.*



3 *Any dark lines that remain after sanding indicate low areas. Continue sanding until all the marks disappear.*

Mortising Machine

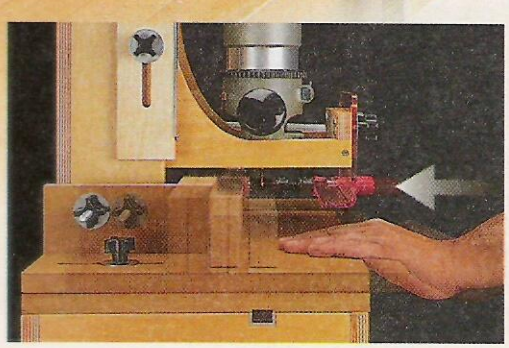
Rout precision mortises in less than a minute with this simple, shop-built machine.

For years now, I've been making mortises by drilling a series of overlapping holes and removing the ridges with a chisel. It works fine, especially if I've only got a few mortises to cut. But recently I was building a project that required cutting over a hundred mortises. That's when I decided to put off cutting the mortises for awhile and build a project that's been on the back burner for quite some time — a shop-made mortising machine, see photo.

ROUTER & SPIRAL BIT. This mortising machine works together with a router and a spiral (upcut) bit to cut the mortises. It's quick, and it's accurate. In fact, it's a great way to make mortises even if you only have a few of them to cut.

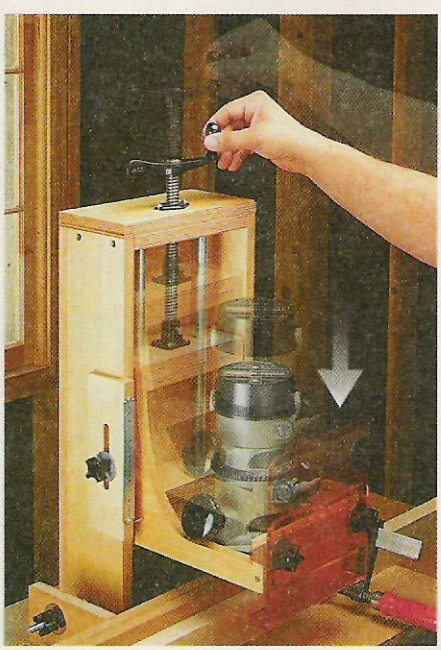
SLIDING TABLE. The way it works is simple. The workpiece is clamped on a table that slides in *two* directions: *in and out* and *side to side*, see photos A and B below. This establishes the location *and* the length of the mortise.

CARRIAGE. To provide the *up and down* movement that's needed to cut the depth of the mortise, the router is mounted to a sliding carriage. Turning a crank lowers the carriage and plunges the spinning bit into the workpiece, see photo C.

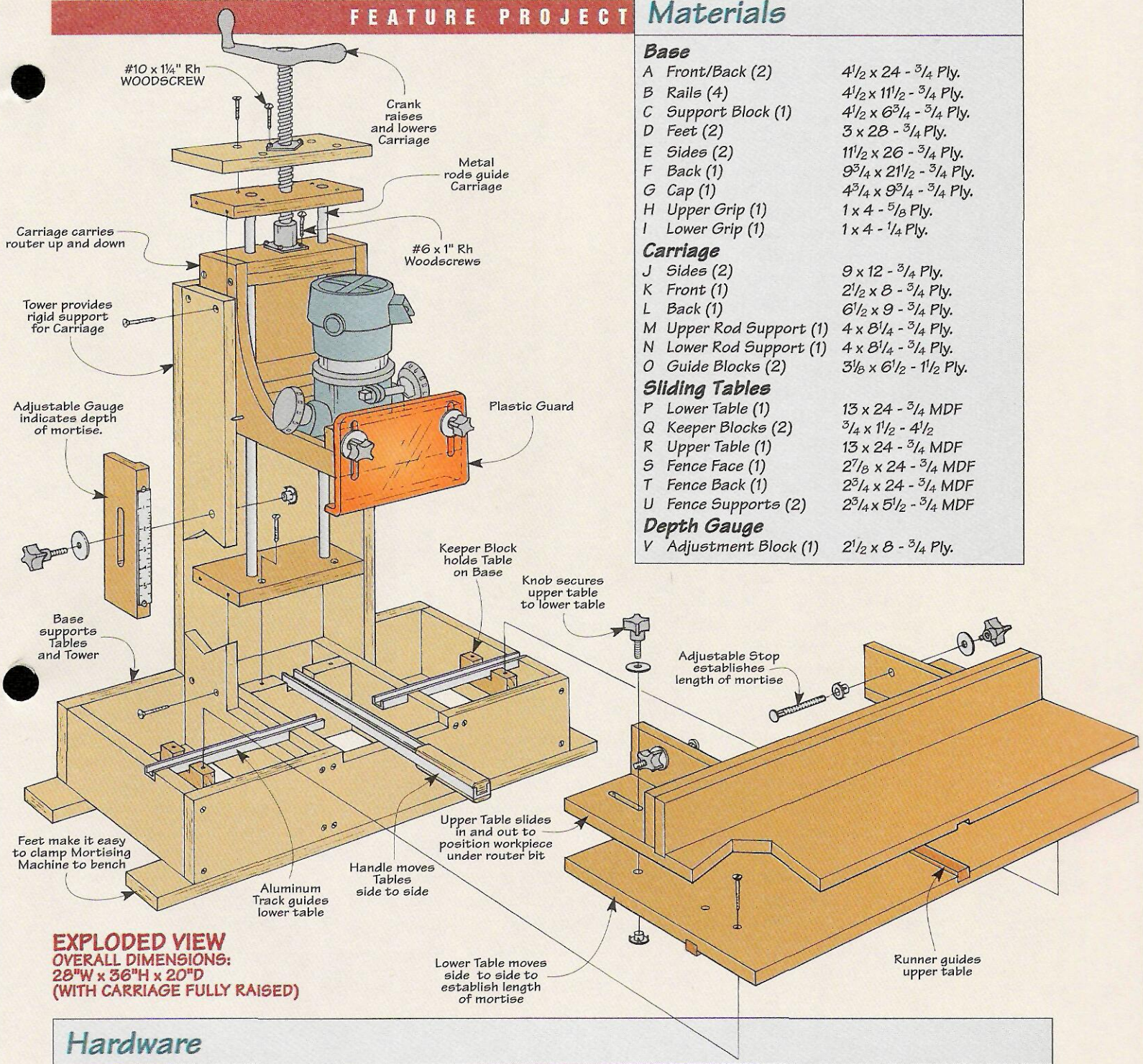


A. Location. It's easy to establish the location of the mortise on a workpiece. Just slide the table in or out to position the piece under the bit.

B. Length. To cut the mortise to length, use the handle to slide the table from side to side. Two stops control the amount of movement.



C. Depth. Turning a crank raises and lowers the router carriage and provides control over the depth of the mortise.


#10 x 1¼" Rh WOODSCREW
Crank raises and lowers Carriage
Metal rods guide Carriage
Carriage carries router up and down
#6 x 1" Rh Woodscrews
Tower provides rigid support for Carriage
Adjustable Gauge indicates depth of mortise.
Plastic Guard
Keeper Block holds Table on Base
Knob secures upper table to lower table
Base supports Tables and Tower
Adjustable Stop establishes length of mortise
Upper Table slides in and out to position workpiece under router bit
Feet make it easy to clamp Mortising Machine to bench
Handle moves Tables side to side
Aluminum Track guides lower table
Lower Table moves side to side to establish length of mortise
Runner guides upper table

EXPLODED VIEW
OVERALL DIMENSIONS:
28"W x 36"H x 20"D
(WITH CARRIAGE FULLY RAISED)

Materials

Base		
A	Front/Back (2)	4½ x 24 - ¾ Ply.
B	Rails (4)	4½ x 11½ - ¾ Ply.
C	Support Block (1)	4½ x 6¾ - ¾ Ply.
D	Feet (2)	3 x 28 - ¾ Ply.
E	Sides (2)	11½ x 26 - ¾ Ply.
F	Back (1)	9¾ x 21½ - ¾ Ply.
G	Cap (1)	4¾ x 9¾ - ¾ Ply.
H	Upper Grip (1)	1 x 4 - ⅝ Ply.
I	Lower Grip (1)	1 x 4 - ¼ Ply.
Carriage		
J	Sides (2)	9 x 12 - ¾ Ply.
K	Front (1)	2½ x 8 - ¾ Ply.
L	Back (1)	6½ x 9 - ¾ Ply.
M	Upper Rod Support (1)	4 x 8¼ - ¾ Ply.
N	Lower Rod Support (1)	4 x 8¼ - ¾ Ply.
O	Guide Blocks (2)	3⅛ x 6½ - 1½ Ply.
Sliding Tables		
P	Lower Table (1)	13 x 24 - ¾ MDF
Q	Keeper Blocks (2)	¾ x 1½ - 4½
R	Upper Table (1)	13 x 24 - ¾ MDF
S	Fence Face (1)	2⅞ x 24 - ¾ MDF
T	Fence Back (1)	2¾ x 24 - ¾ MDF
U	Fence Supports (2)	2¾ x 5½ - ¾ MDF
Depth Gauge		
V	Adjustment Block (1)	2½ x 8 - ¾ Ply.

Hardware

- (4) #6 x 1" Rh Woodscrews
- (2) #8 x ½" Rh Woodscrews
- (8) #8 x ¾" Fh Woodscrews
- (20) #8 x 1¼" Fh Woodscrews
- (78) #8 x 1½" Fh Woodscrews
- (4) #8 x 2" Fh Woodscrews
- (1) #8 x 1" Rh Woodscrew
- (2) #10 x 1¼" Rh Woodscrews
- (7) 5/16"-18 T-nuts (w/prongs)
- (7) 5/16" Fender Washers
- (1) 3/16" Washer
- (1) #12 Flat Washer
- (1) ¼" x 1¼" Hex Bolt
- (1) ¼" Lock Nut
- (2) 5/16" x 3½" Carriage Bolts
- (2) 5/16" Knobs (w/ thru hole)
- (3) 5/16" Knobs (w/ 1" stud)
- (2) 5/16" Knobs (w/ 1½" stud)
- (2) ⅝" x 21¼" Metal Rods
- (4) ⅝" I.D. x ¾" O.D. Bronze Bushings (1" Long)
- (1) 6¾" x 10¾" Phenolic Plate (⅜" Thick)
- (1) ¾" x 8⅛" Phenolic Strip (⅜" Thick)
- (2) ¾" x 11" Phenolic Strip (⅜" Thick)
- (2) ½" x 1" - 9¾" Aluminum Channel (⅛" Thick)
- (1) ½" x 1" - 16" Aluminum Channel (⅛" Thick)
- (1) 11/16" Dia. Crank (9" Long)
- (1) ¼" I.D. x ¾" O.D. Sealed Ball Bearing (R4)
- (1) Bit Guard (Optic Orange)
- (1) 6" Steel Rule
- (1) 8d Finish Nail

For a complete hardware kit that includes all the hardware listed here, refer to Sources on page 31.

Note: If you'd like to order the crank for the carriage separately, you can call the Adjustable Clamp Co. at 312-666-0640. Ask for part no. 6709.

The bronze bushings and bearing are also available separately by calling Standard Bearings at 800-554-8123.

Base

I began by makin g the base of the mortising machine. The *base* provides a mounting surface for a metal track that guides the sliding tables, see drawing. In addition, it serves as a foundation for a tall, vertical *tower* that houses the router carriage.

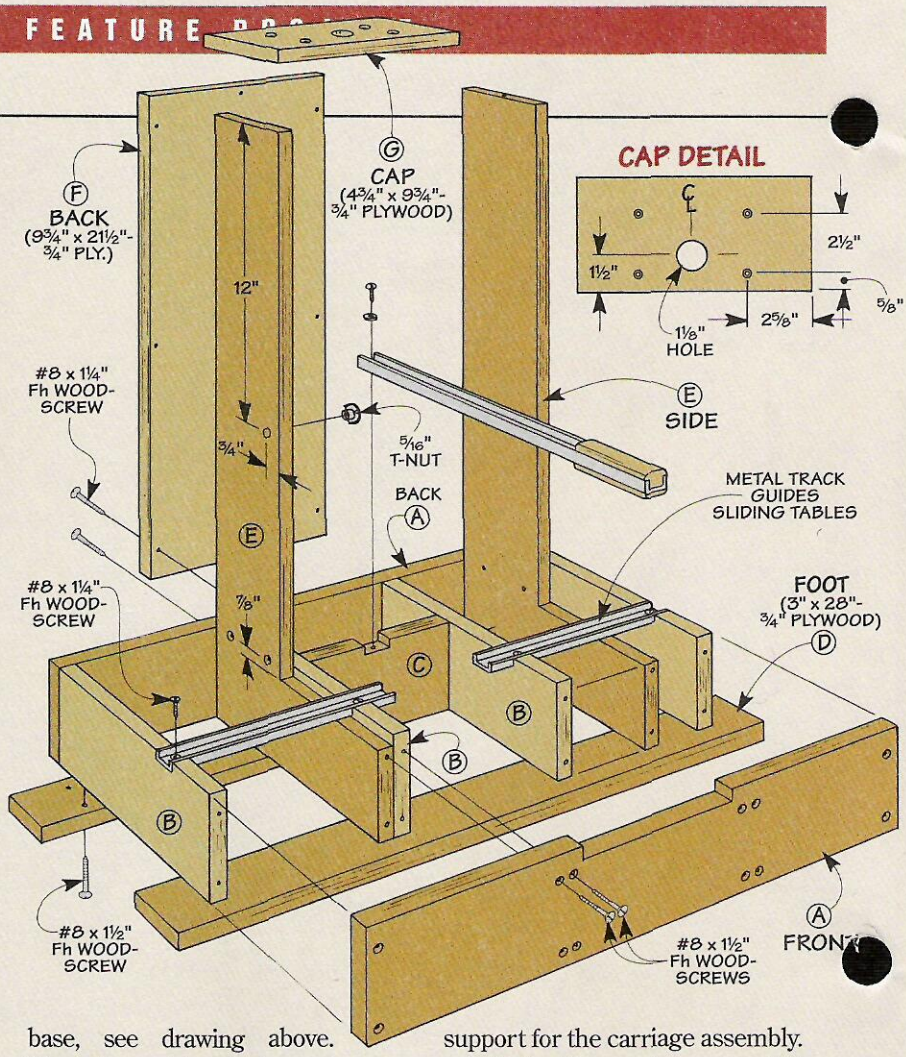
FRAME. The base starts out as a simple plywood frame. The *front* and *back (A)* of this frame are identical in size, see Fig. 1. But to allow clearance for a handle, you'll need to cut a long notch in the front piece.

The front and back are connected by four *rails (B)* that are notched to accept the metal track. To prevent the table from binding, it's important for these notches to line up.

An easy way to accomplish this is to first mount a dado blade in the table saw. Then butt each rail against a stop block clamped to a fence on the miter gauge, see Fig. 2. After making a single pass for each rail, reposition the stop block and make a second pass to complete the notches.

SUPPORT BLOCK. Before assembling the base, I added a plywood *support block (C)* to hold the end of the handle. After notching the support block to accept the handle, it's screwed to the two inside rails to form an H-shaped assembly. Then just screw the rails to the front and back.

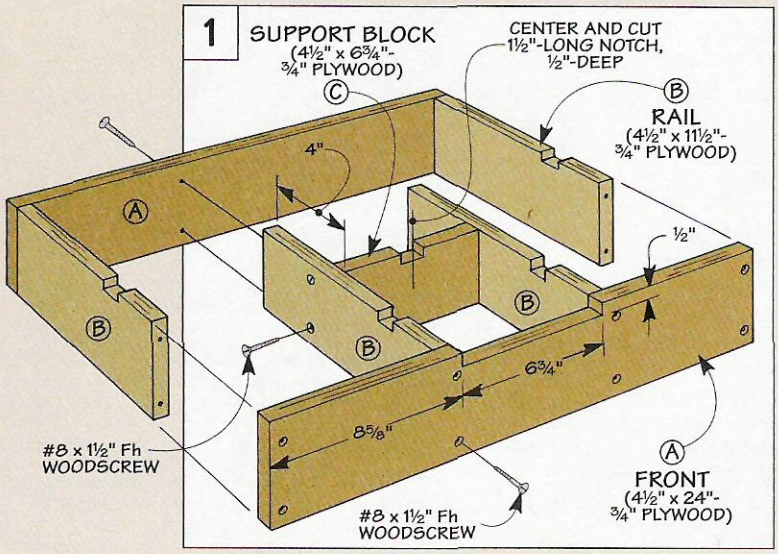
FEET. This is also a good time to add two *feet (D)* to the bottom of the base, see drawing above. These long strips of plywood extend past the base so you can clamp the mortising machine to your bench.

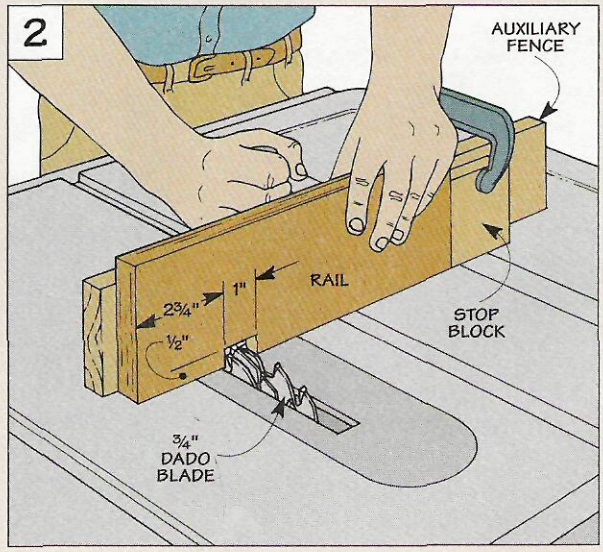


TOWER

Once the base is assembled, the next step is to add the tower. Basically, it's a tall, open box that provides rigid support for the carriage assembly.

SIDES. The main parts of the tower are two L-shaped *sides (E)*. To cut the long "leg" of each side, I ran a large plywood blank against the rip fence on the table saw, see Fig. 3. But because the saw blade won't make a square corner, I stopped the cut about 1" from the layout line.





Now it's just a matter of cutting the short "leg" of the sides, see Fig. 4. Here again, stop the cut before you get to the corner. Then trim off the waste piece with a hand saw.

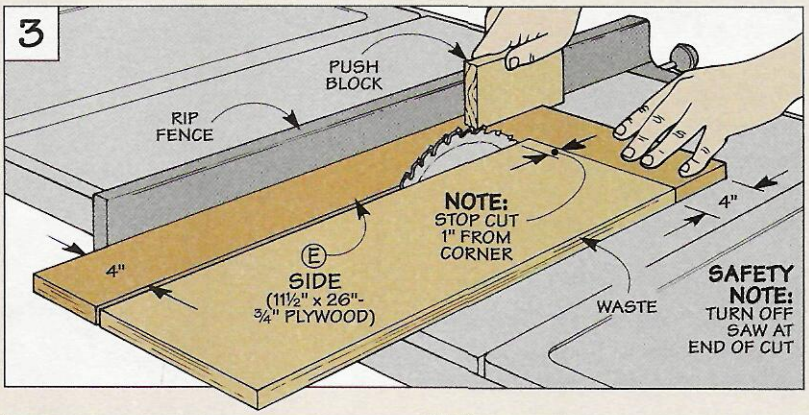
Before attaching the sides, it's best to predrill two countersunk shank holes near the inside corner of each piece, see drawing on page 18. (This will help simplify the carriage assembly.) I also installed a T-nut in the *left* side to hold a depth gauge that's added later.

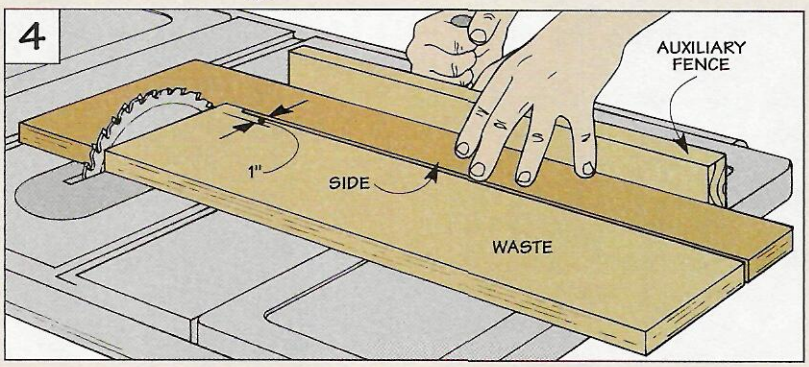
Now you can glue and clamp the sides of the tower to the inside rails. Then drive screws through the front and back into the sides.

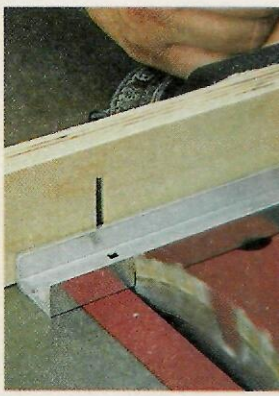
BACK. Next, to prevent the tower from racking, I added a plywood *back (F)*. It's cut to fit flush with the top edge and outside face of each side.

CAP. After screwing the back in place, all it takes to enclose the top of the tower is a plywood *cap (G)*. It's easiest to drill a hole in the cap now to accept the crank that's added later. And here again, predrill the holes that will be used when fastening the cap to the carriage assembly.

TRACK. At this point, you can set the cap aside and concentrate on the metal track that guides the tables side to side. The track consists of two pieces of aluminum channel that fit into the notches in the rails, see Fig. 5. Why not just make one long track? Because two pieces will create an opening that provides clearance for the handle to swing back and forth. After cutting the two pieces of track to final length (see photo at right), they're screwed to the rails.





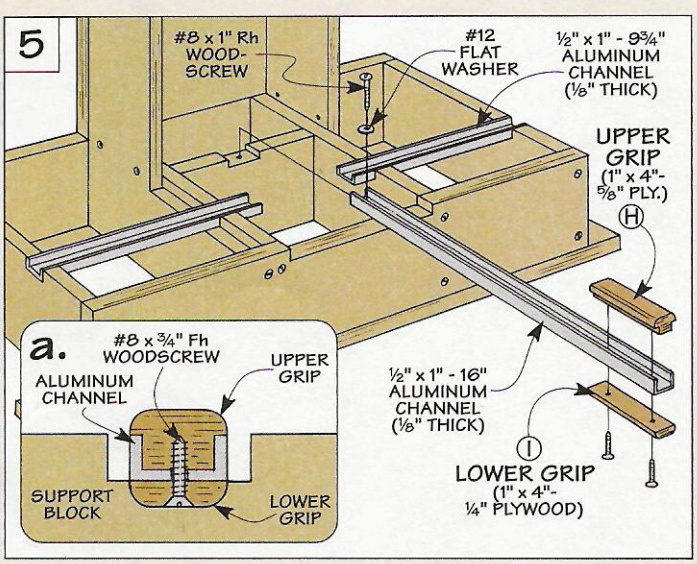


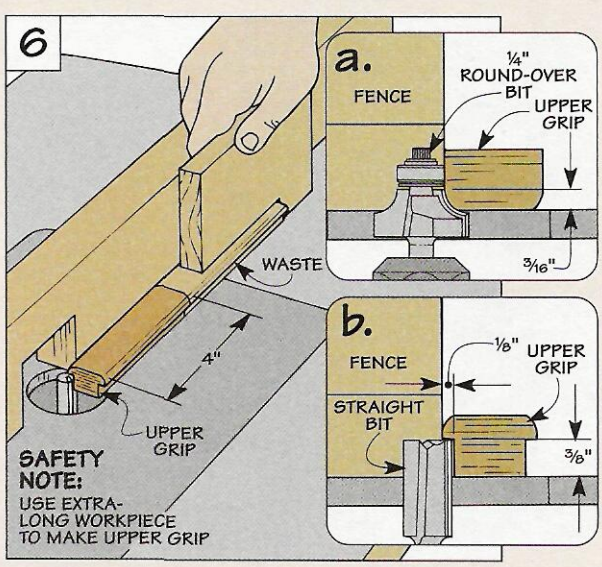
▲ *The aluminum channel used for the track and the handle is quite soft, so it cuts easily with a carbide-tipped saw blade.*

HANDLE. As I was working with the aluminum channel, it occurred to me it would also be a good material to use for the *handle* that moves the table from side to side.

To prevent the channel from digging into my hand, I used a couple scraps of plywood to make a comfortable grip, see Fig. 5. The *upper grip (H)* starts out as an extra-long strip that's resawed to ⅝" thick, see Fig. 6. After rounding over the top edges of this strip (Fig. 6a), it's rabbeted to fit inside the channel, see Fig. 6b. For the *lower grip (I)*, I resawed a scrap to a thickness of ¼". After fitting the upper grip in the channel, the lower grip is screwed in place, see Fig. 5a. Then file and sand the edges smooth.

ATTACH HANDLE. Once the grip is completed, the opposite end of the handle can be screwed in place.





Carriage Assembly

The carriage assembly consists of two main parts: a *carriage* that holds the router, and a *guide system* that allows the carriage to travel up and down a pair of metal rods, see Fig. 7.

CARRIAGE

To provide easy access to the router (and clearance for the handles), the carriage is open in front, and each side has a large, sweeping curve.

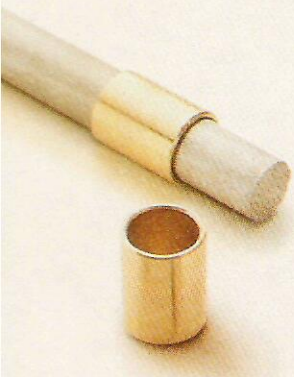
CONSTRUCTION. The two *sides (J)*, *front (K)*, and *back (L)* of the carriage are all made of ¾" plywood, see Fig. 8. To hold a mounting plate for the router, you'll need to cut a groove in each piece. As for the curved sides, don't worry about their exact shape. Just be sure there's enough clearance for the router handles.

The next step is to notch the bottom corners of the front (K) to fit over the sides. Also, installing two T-nuts provides a way to attach a guard for the router bit.

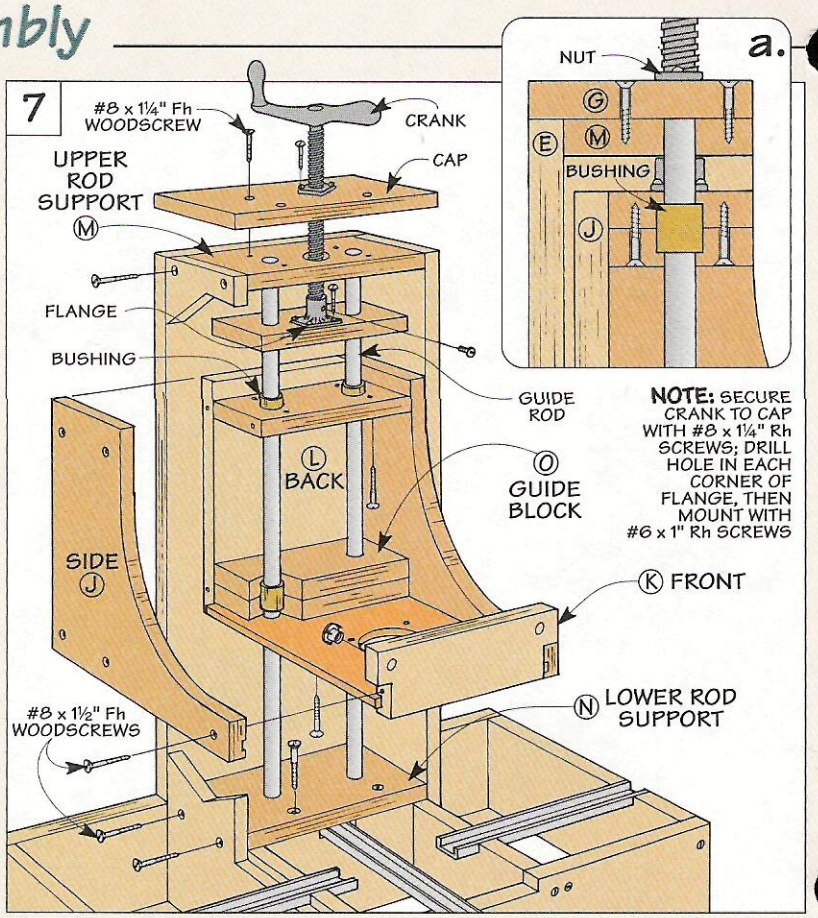
MOUNTING PLATE. Now you're ready to add the *mounting plate*, see Fig. 9. To provide solid support for the router, I made the plate from a rigid plastic material called phenolic. (For sources of phenolic, see page 31.)

To create an opening for the router bit, there's a large hole cut in the mounting plate, see Fig. 9. This hole is much larger than necessary. But this creates a "window" that makes it easy to see the workpiece when setting up the mortising machine.

In addition to the large hole, you'll need to drill two holes near the back edge of the mounting plate to slip over the metal rods. A countersunk shank hole in between (drilled from the bottom) will be used to secure the mounting plate to a guide block. Also, don't forget to locate and drill mounting holes for your router.



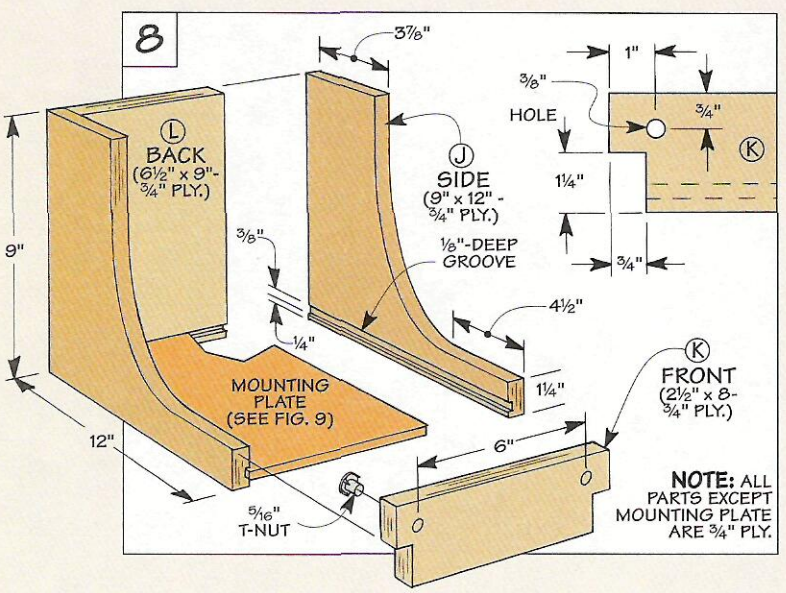
▲ *Bronze bushings that slip over the metal guide rods create an accurate guide system for the carriage.*

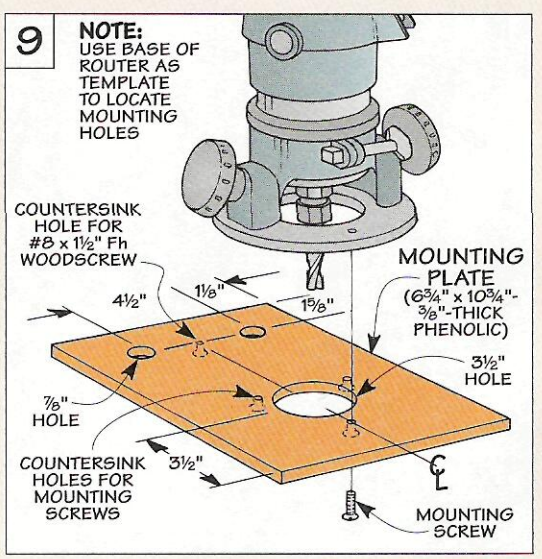


GUIDE SYSTEM

At this point, you can set the carriage pieces aside for awhile and concentrate on the guide system.

GUIDE RODS. The heart of this system is a pair of metal *guide rods*,





see drawing at right. These rods pass through a number of plywood blocks *and* the mounting plate. (I picked up a long metal rod at the hardware store and cut each of the guide rods to final length with a hacksaw.)

SUPPORT BLOCKS. The ends of the rods are held in place by an *upper (M)* and *lower rod support (N)*. And two thick *guide blocks (O)* attached to the carriage slide up and down the rods as you turn the crank on top of the mortising machine, see Fig. 7. Note: Each guide block starts out as two oversize pieces of ¾" plywood.

BUSHINGS. To eliminate "play" in the carriage, the rods slip through bushings captured inside pockets in the guide blocks, see Fig. 7a and photo on page 20. But the bushings don't ensure the carriage will slide smoothly without binding. That depends on the rods being *parallel* to each other. This means the holes in one block need to line up with the holes in the others.

To accomplish that, I started with six identical blocks (one for the upper and lower rod support and four for the guide blocks). Then I clamped two stop blocks to a fence on the drill press to position each piece, see Fig. 10.

DRILL HOLES. To form the pockets for the bushings, begin by drilling ¾"-dia. counterbores in the pieces that make up the guide blocks (O). Then follow up with ⅝" *through* holes for the guide rods. I also drilled the holes in the upper rod support (M) all the way through. But to prevent the guide rods from slipping through the lower rod support (N), I drilled stopped holes in it.

After completing all the holes, fit the bushings into the pockets and screw the guide blocks together. Then trim the waste off both ends and the back edges of the guide blocks.

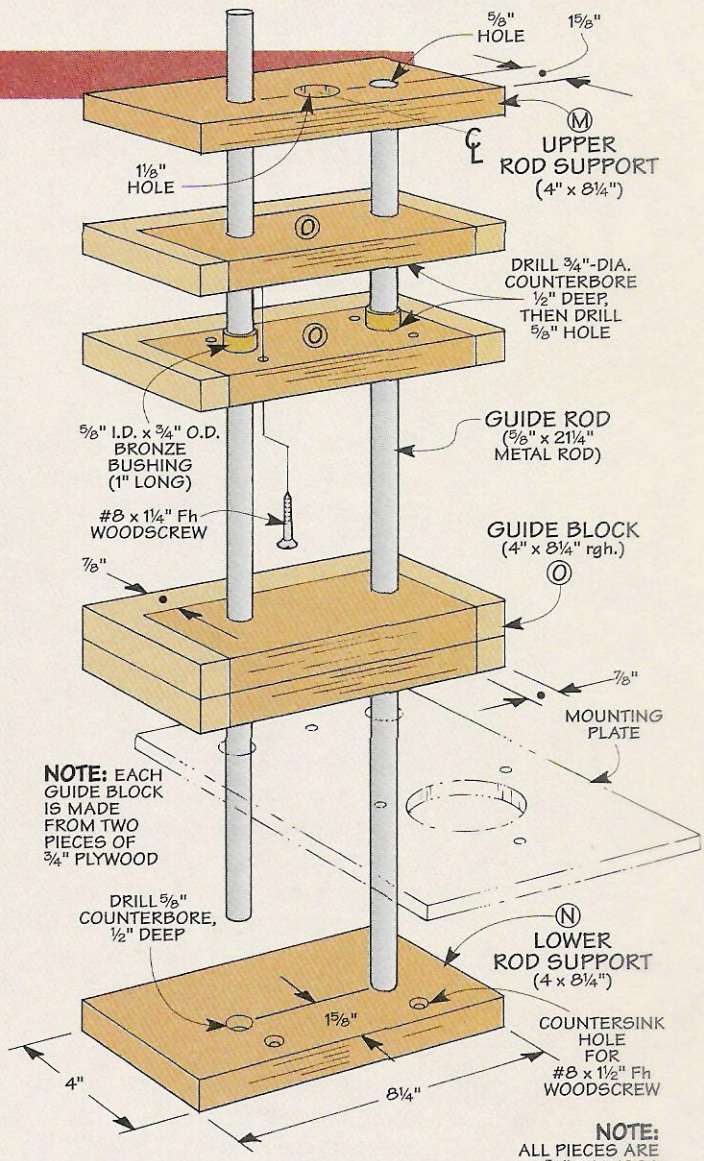
CARRIAGE ASSEMBLY. At this point, you're ready to assemble the carriage. Start by sliding the rods through the guide blocks and mounting plate. Then, after clamping the sides (J), front (K) and back (L) in place, simply screw the carriage together, see drawing below right.

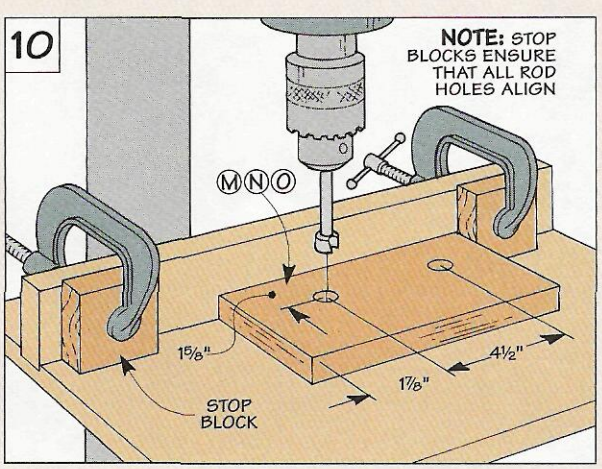
Before installing this assembly, you'll need to screw the lower rod support (N) to the base, see Fig. 7. Then after drilling a hole in the upper rod support (M) to accept the crank, slip it over the guide rods.

Now set this assembly inside the tower and fit the rods into the holes in the lower rod support. It's secured by driving screws through the sides of the tower into the upper rod support. Attaching the cap (G) with screws will make it easy to install the crank.

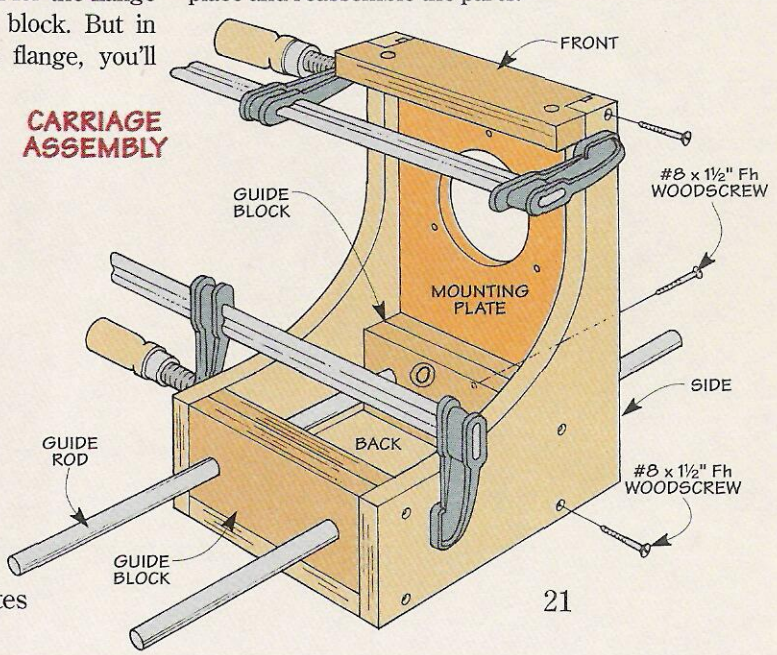
MOUNT CRANK. The first step is to remove the mounting flange from the end of the crank. (A single screw holds it in place.) After inserting the threaded part of the shaft through the top of the tower, just screw the "nut" on the crank to the cap. Note: You'll need to reverse the "nut" before screwing it to the cap.

Once the crank is secured, you can mark the location for the flange on the upper guide block. But in order to attach the flange, you'll need some knuckle room. I found it easiest to remove the upper rod support, cap, and crank. (This entire assembly is held in place with the four screws that hold the upper rod support.) Finally, screw the flange in place and reassemble the parts.


⅝" HOLE
1⅝"
Ⓜ UPPER ROD SUPPORT (4" x 8¼")
1⅛" HOLE
DRILL ¾"-DIA. COUNTERBORE ½" DEEP, THEN DRILL ⅝" HOLE
⅝" I.D. x ¾" O.D. BRONZE BUSHING (1" LONG)
GUIDE ROD (⅝" x 21¼" METAL ROD)
#8 x 1¼" Fh WOODSCREW
GUIDE BLOCK (4" x 8¼" rgh.) Ⓞ
⅞"
⅞"
MOUNTING PLATE
NOTE: EACH GUIDE BLOCK IS MADE FROM TWO PIECES OF ¾" PLYWOOD
DRILL ⅝" COUNTERBORE, ½" DEEP
Ⓝ LOWER ROD SUPPORT (4 x 8¼")
1⅝"
COUNTERSINK HOLE FOR #8 x 1½" Fh WOODSCREW
4"
8¼"
NOTE: ALL PIECES ARE ¾" PLYWOOD



CARRIAGE ASSEMBLY



Sliding Tables

This mortising table is designed with *two* sliding tables. A *lower table* moves from side to side, see Fig. 11. And an *upper table* that rides piggyback on top slides in and out.

LOWER TABLE

To provide the movement that's needed to cut a mortise to length, the lower table slides back and forth in the metal track in the base.

NOTCH. The *lower table (P)* starts out as a piece of ¾" MDF with a wide notch cut in the back edge, see Fig. 12. This notch is sized to provide clearance around the tower as the table moves from side to side.

RUNNERS. To guide the table, I made two *lower runners* that fit inside the aluminum track. These runners fit in a groove cut in the bottom of the table. In addition, a third runner attached to the *top* of the table serves as a track for the *upper table*. This *upper runner* fits in a dado cut in the top of the table.

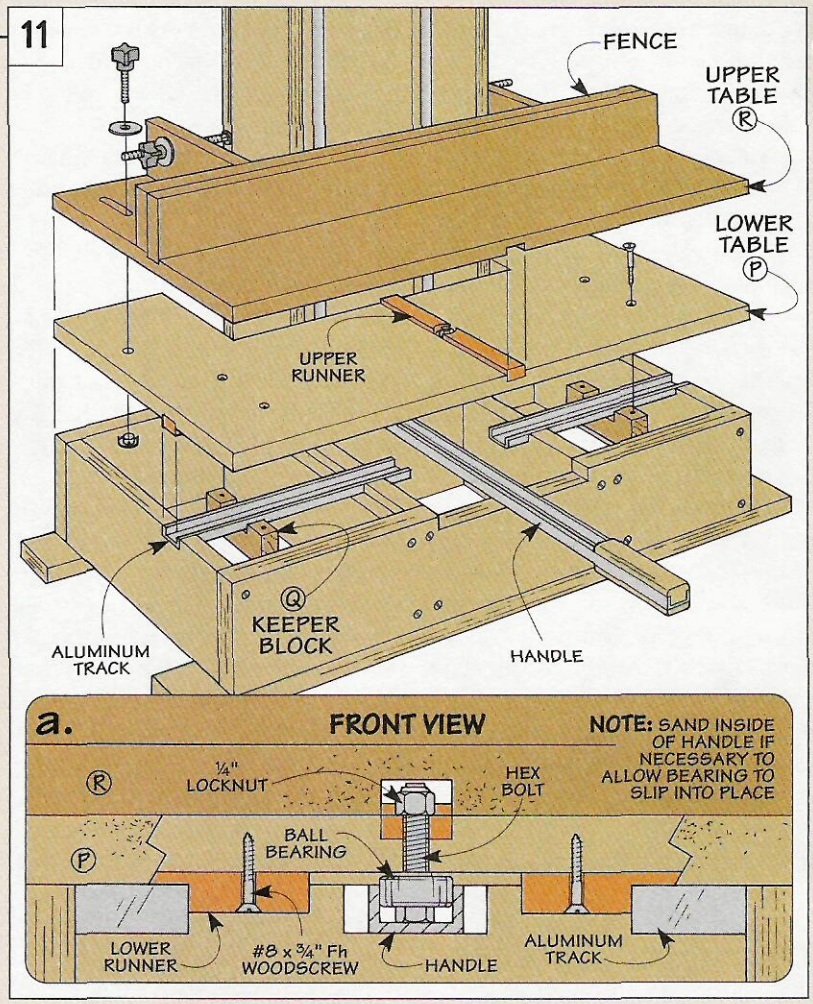
After cutting all the runners to size, the next step is to screw the two lower runners in place so they're flush with the ends of the table. This creates an opening between the runners for a bearing that fits into the groove under the table, see Fig. 12b.

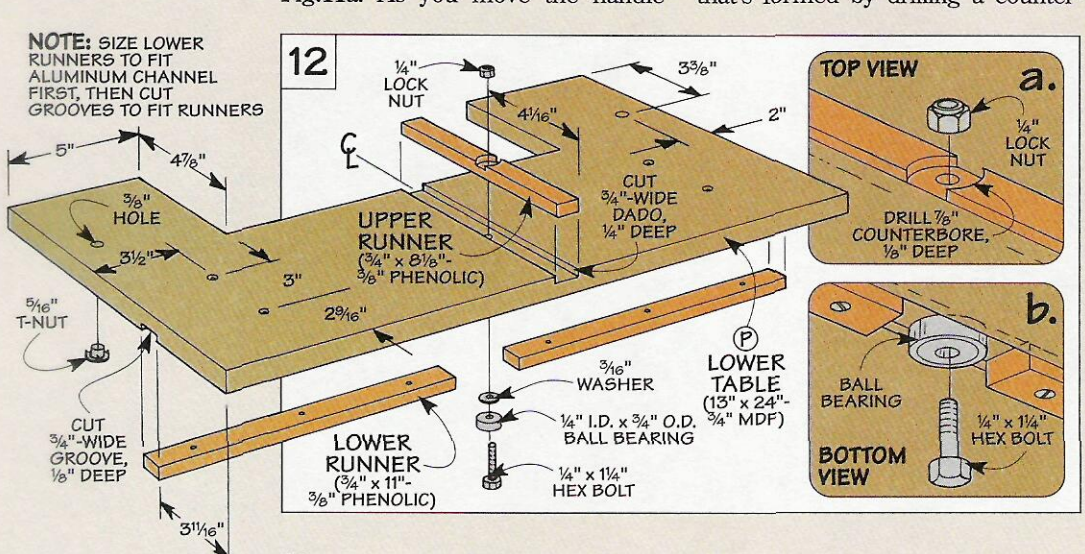
BEARING. The purpose of this bearing is simple. When the table is installed, the bearing fits *inside* the channel that forms the handle, see Fig.11a. As you move the handle back and forth, it exerts pressure against the bearing which slides the table smoothly from side to side.

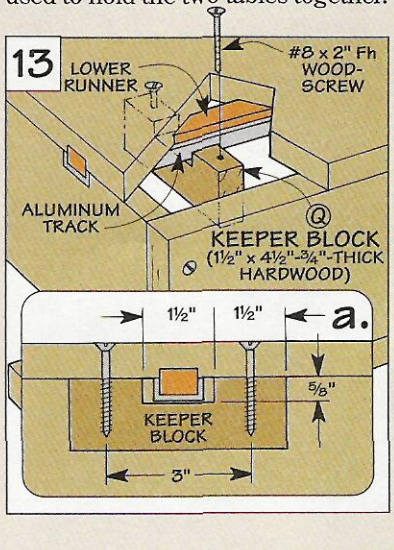
The bearing is secured to the table with a bolt and lock nut. And I used these same fasteners to secure the upper runner. The nut sits in a recess that's formed by drilling a counterbore in the runner, see Fig. 12a. This prevents the upper table from hitting the lock nut as it slides on the runner.

T-NUTS. With the upper runner in place, I added two T-nuts, one near each of the back corners of the table, see Fig. 12. Later, the T-nuts are used to hold the two tables together.

▲ *To resist wear, the runners are made from hard, durable phenolic.*







INSTALL TABLE. Now you're ready to install the table. You may have to jockey it around a bit to fit the bearing down in the handle and to get the runners to slip into the track.

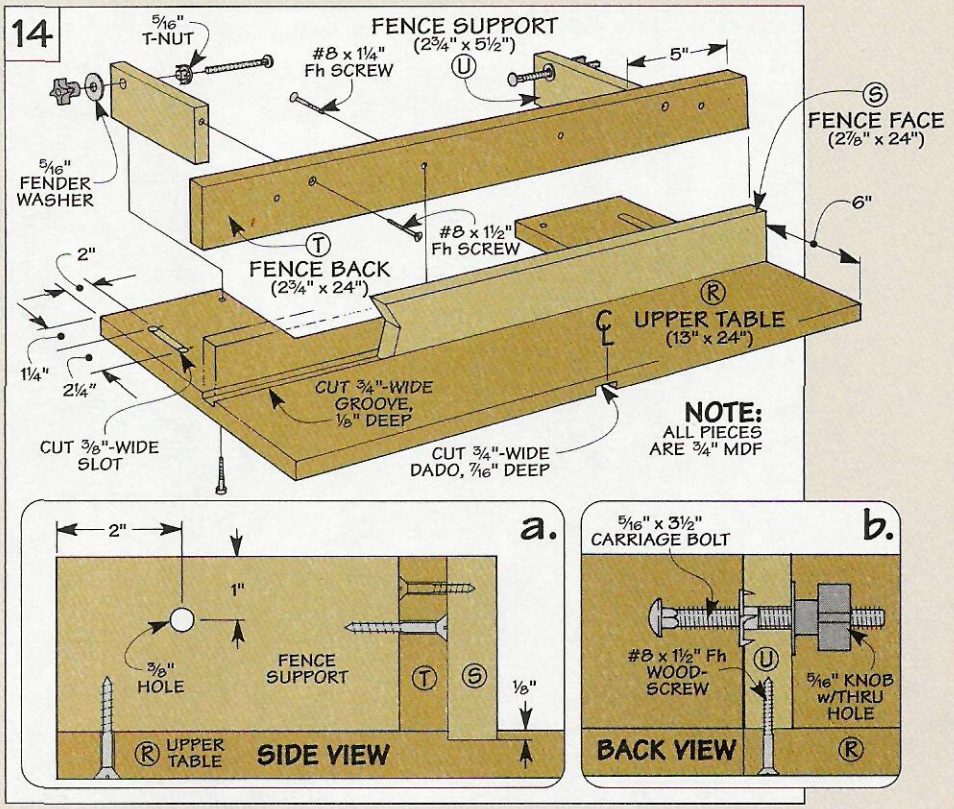
KEEPER BLOCKS. With the table in place, I added two hardwood *keeper blocks (Q)*, see Figs. 13 and 13a. These blocks prevent the table from lifting up when working with long pieces that hang over the base. To do this, the blocks are notched to fit around the track and screwed to the table.

UPPER TABLE

At this point, you can turn your attention to the *upper table*, see Fig. 14. This table slides in and out on the runner that's mounted to the top of the lower table. Plus, it provides a platform for a fence that's used to clamp the workpiece in place.

It's this front and back movement that establishes the location of the mortise on the edge of a workpiece. To get the mortise to end up where you want it, you simply slide the table in or out to position the workpiece under the bit. Then, by tightening the two tables together, they move as a *single* unit when cutting the mortise.

CONSTRUCTION. The *upper table (R)* is identical in size to the lower table. And once again, it's notched to provide clearance around the tower. But this time, I cut a pair of adjustment slots in the table. Also, cutting a dado in the bottom of the table allows it to fit over the upper runner. What you want here is to size the dado to create a smooth, sliding fit.



There's just one thing left to do before adding the fence. That's to cut a groove in the top of the table to accept one of the fence pieces.

FENCE

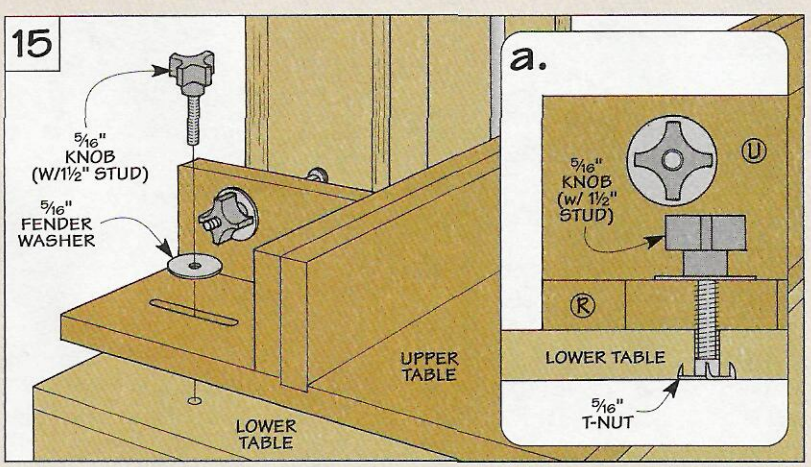
In addition to supporting a workpiece, the fence provides a way to mount a stop system that controls the side to side movement of the sliding tables.

The fence is made up of several parts. To position the workpiece on the table, the *face (S)* is a long strip of MDF that's screwed into the groove in the top of the table, see Fig. 14. To strengthen the face, I added a *back (T)* and two *supports* (U). Before screwing these pieces together, it's best to install a T-nut in each support that's part of the stop system. Then screw the supports to the table and fasten the fence back (T) and face (S) together with screws.

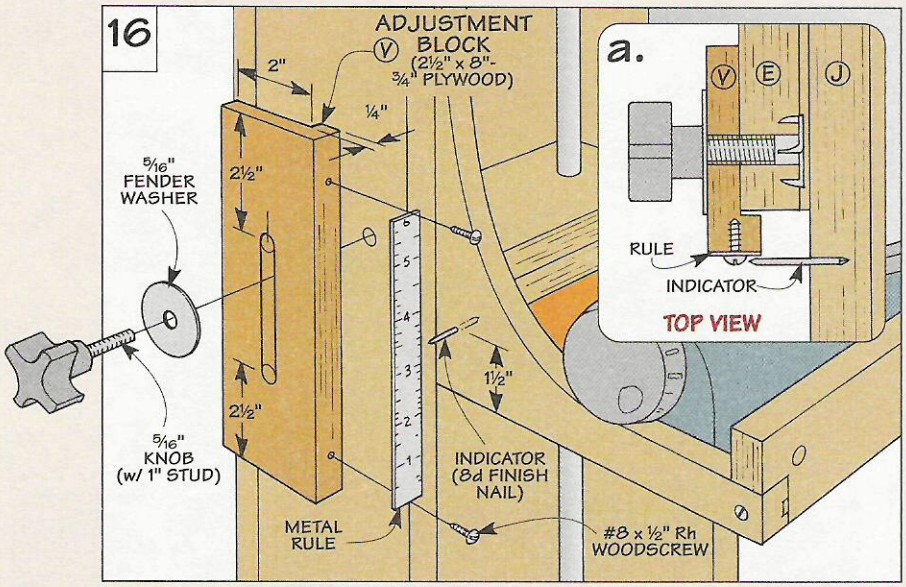
INSTALL UPPER TABLE. Now you can install the upper table. This is just a matter of setting it in place and fastening the upper and lower tables together with two threaded knobs. The knobs pass through the slots in the upper table and into the T-nuts in the lower table, see Figs. 15 and 15a.

STOP SYSTEM. All that's left is to add the stop system, see Fig. 14b. It determines the amount of side to side movement of the tables. The key to the stop is a bolt that threads into the T-nut in each support. When you slide the table to the *right*, the head of the bolt in the *left* support contacts the tower and "stops" the table. The opposite stop works the same way.

To adjust the stops, it's just a matter of threading the bolts in or out. Tightening a knob on the end of each bolt locks in the adjustment.



Depth Gauge



To see at a glance when the mortise is cut to the desired depth, I added a depth gauge to the side of the tower.

There's nothing complicated about this gauge. It's just a 6" metal rule attached to a plywood *adjustment block (V)*, see Fig. 16. A long slot in the adjustment block lets you raise and lower the depth gauge. Also, cutting a wide rabbet forms a lip that fits over the edge of the tower, see Fig. 16a. This lip keeps the depth gauge aligned as you move it up and down.

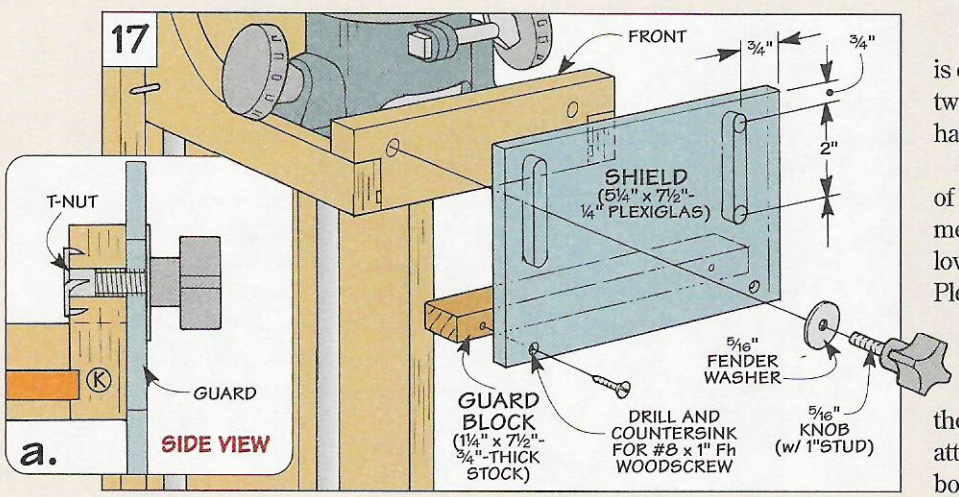
ATTACH RULE. The metal rule is attached with two screws. Tightening the screw heads against the rule holds it securely in place.

INSTALL GAUGE. Now you can install the gauge. A threaded knob that passes through the adjustment block and into the T-nut (installed earlier) is all that's needed here.

INDICATOR. To make it easy to "read" the depth gauge, I added an indicator to the side of the carriage. It's just a nail with the head snipped off. After drilling a hole for the nail, I used epoxy to hold it in place.

SETUP. To use the depth gauge, lower the carriage until the tip of the bit touches the workpiece. Then adjust the gauge so the indicator points to the *final* depth of the mortise. As you lower the carriage to make a series of successive cuts, the indicator will eventually point to the *bottom end* of the rule. That's when you know the mortise is at the correct depth.

Router Bit Guard



Since the router bit is exposed below the carriage, it's a good idea to add a guard for safety.

Note: The guard shown here is made from scrap pieces of material. But if you prefer a single-piece plastic guard like the one shown in the photo on page 16, it's available as part of our complete hardware kit. (See page 31 for Sources.)

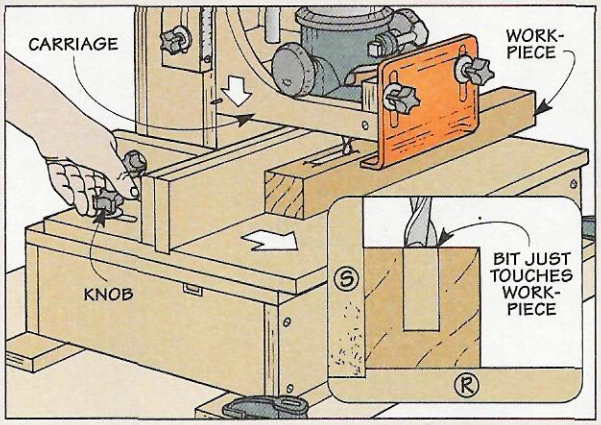
The guard that's shown in Fig. 17 is quite simple. In fact, there are only two pieces: a plastic *shield* and a hardwood *guard block*, see Fig. 17.

SHIELD. The shield is just a piece of Plexiglas with a couple of adjustment slots that allow you to raise and lower the guard. Note: You can find Plexiglas at most home centers.

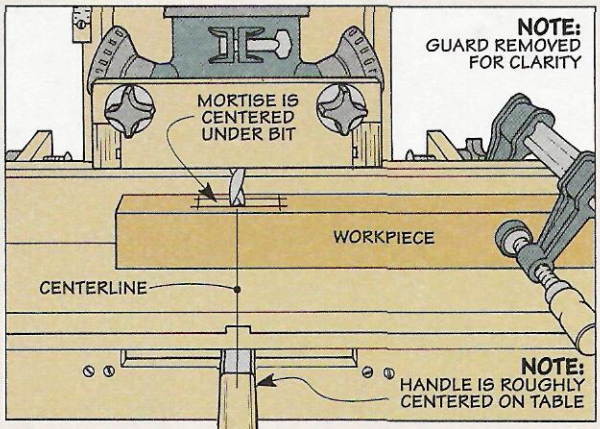
GUARD BLOCK. Although the shield extends down in front of the carriage, I also wanted part of the guard to extend *underneath*. So I attached the guard block to the bottom edge with screws.

MOUNTING. To hold the guard in place, I used a couple of plastic knobs and a pair of fender washers. The knobs are threaded into the T-nuts that were added earlier to the front (K) of the carriage, see Fig. 17a.

Setup & Use

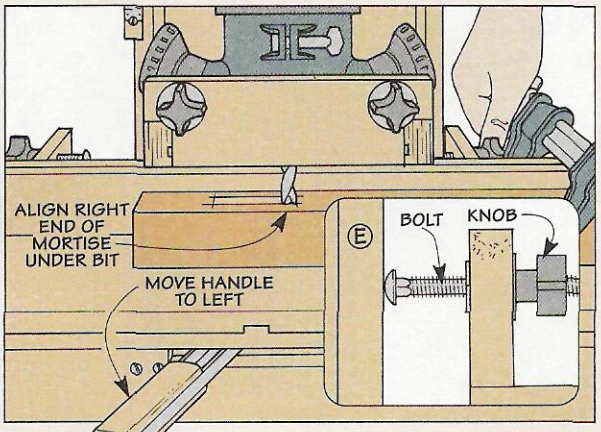


1 *To set up the mortising machine, lay out the mortise and butt the workpiece against the fence. Now lower the carriage, slide the table in or out (so the bit will cut the mortise at the desired location), and lock the knobs.*

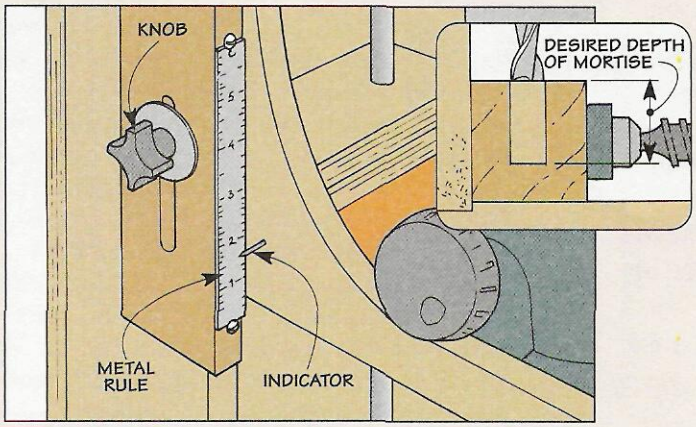


2 *All it takes to establish the final position of the workpiece is to slide it along the fence until the bit is centered on the length of the mortise. Then simply clamp the workpiece to the fence.*

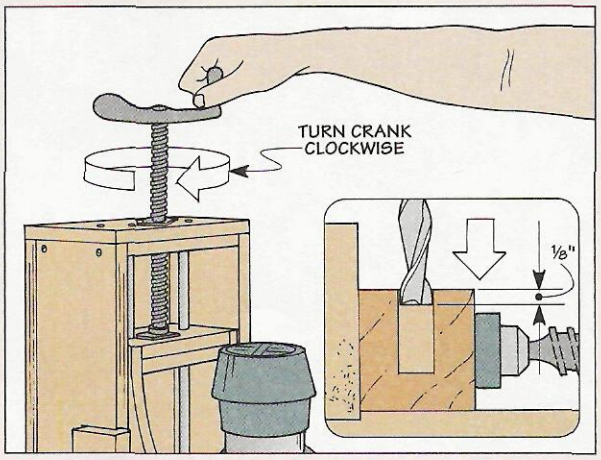
▲ *The secret to cutting a crisp, clean mortise is to make a series of shallow passes.*



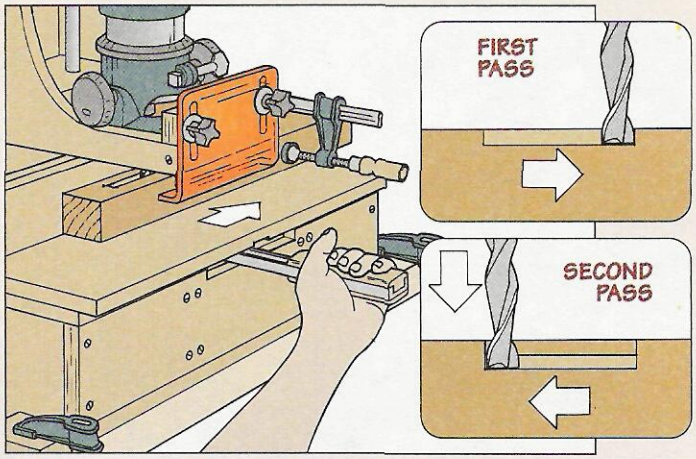
3 *To set the stops, slide the handle to the left until the bit aligns with the right end of the mortise. Then adjust the bolt so it contacts the tower. After locking the stop, repeat the process for the other side.*



4 *With the tip of the router bit still touching the workpiece, adjust the depth gauge so the indicator points to the desired depth of the mortise. Then tighten the knob to lock the gauge in place.*



5 *Now you're ready to flip the switch on the router and start cutting the mortise. To do this, turn the crank to lower the carriage and plunge the bit into the workpiece. A shallow (1/8"-deep) cut works best.*



6 *After sliding the handle to the right until it stops, lower the carriage another 1/8" and push the handle all the way in the opposite direction. Continue this process until the mortise is cut to the desired depth.*

Brush up on the Basics

One of the secrets to ending up with a smooth, even finish is selecting the right brush and using a few simple techniques.

Q: *I often use "throwaway" foam brushes to apply a finish, but I'm not always satisfied with the results. Would a bristle brush work better? Also, are there any special brush techniques I can use that will ensure good results?*

Frank Haynes
Davenport, Iowa

When it comes to ease of use, a foam brush is hard to beat. They cost next to nothing. But I've had mixed results with them.

So when applying a finish to a special project, I use a bristle brush. There are several advantages to using a quality bristle brush.

First, it holds plenty of finish, so you aren't constantly dipping it back in the container to replenish the brush. (It also isn't as likely to drip.) Second, the bristles allow the finish to flow out smoothly and evenly with very few brush marks.

SELECTING A BRUSH. So how *do* you go about selecting a quality brush? After all, if you walk down the paint aisle at the local home center, there are hundreds of brushes to choose from.

First of all, *any* brush is going to have the same basic parts, see drawing below. But it's the bristles in the brush that make the difference in the quality of the finish.

TYPES OF BRISTLES

You'll find two types of bristles: *natural* and *synthetic*, see photos above.

NATURAL BRISTLES. Like their name implies, *natural bristle* brushes are made from animal hair. As a rule, I use a natural bristle brush to apply a finish like varnish or shellac. These bristles seem to hold more finish. And in general, I get better results.

The only exception is when I'm applying a water-based finish. With this type of finish, the bristles absorb too much water, and they get soft and limp — almost as if they're having a "bad hair" day. This makes it difficult to control the amount of finish I brush onto the workpiece.

SYNTHETIC BRISTLES. So when working with water-based finishes, I use a brush that has *synthetic bristles*. These bristles are made of plastic, so they absorb very little water and won't deform during use.

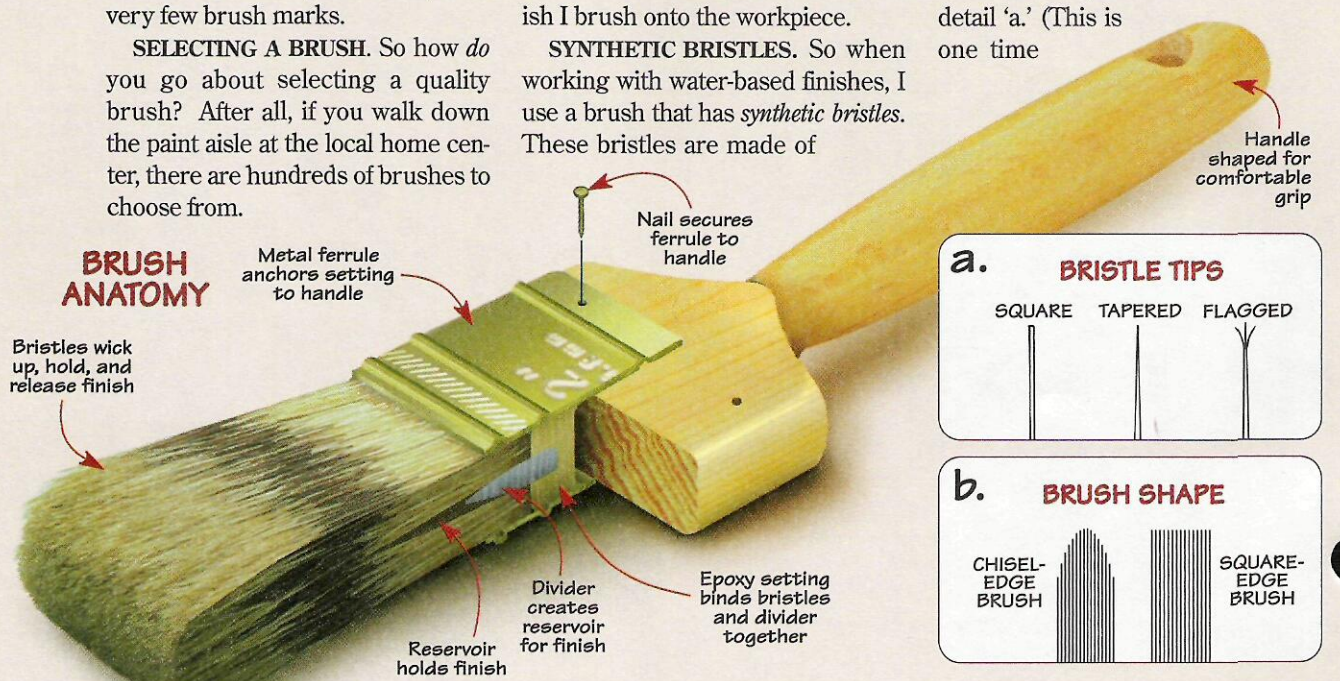
BRISTLE TIPS

Another consideration when choosing a brush is the *tips* of the bristles.

FEEL FOR SOFTNESS. If your eyesight is like mine, it will be impossible to actually *see* the tips of the bristles. But you can *feel* them. Remove the paper "keeper" from the brush and fan the bristles against your hand.

STIFF BRISTLES. If they feel stiff, it's probably because the tips of the bristles are cut *square*, see detail 'a' below. These bristles are okay for general painting jobs, but they make it difficult to brush a smooth finish.

SUPPLE BRISTLES. If the brush has soft, supple bristles, it's a good indication that the bristles are either tapered or, better yet, "flagged" at the ends, see detail 'a.' (This is one time



where "split ends" are desirable.) The flagged (or tapered) tips do a great job of smoothing brush marks.

BRUSH SHAPE

In addition to the tips of the bristles, you'll also want to consider the *shape* of the brush.

CHISEL-EDGED. If the bristles are taller in the center and shorter on the sides, the end of the brush resembles the shape of a chisel, see detail 'b' on page 26. A chisel-edged brush has a slim profile that allows you to apply finish to fine details or to get into hard-to-reach areas.

SQUARE-EDGED. That's more difficult with a square-edged brush (bristles all the same length). Unless you're poking paint into a corner, these brushes aren't worth using.

BRUSH PREPARATION

There's more to getting a smooth finish than using a quality brush. A little preparation now will keep problems from cropping up later.

A. Remove Dust & Bristles. Work the brush back and forth in your palm to remove dust or loose bristles.

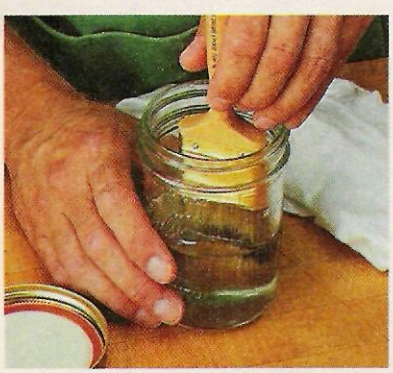
B. Filter Finish. To ensure the finish is clean of dust and debris, filter it into a separate container.

REMOVE DUST. Dust is a big culprit when applying a finish. So make sure there's no dust (or loose bristles) in the brush, see photo A above.

FILTER THE FINISH. It's also a good idea to use a paper filter to remove any dust and debris from the finish, see photo B. By working out of a separate container, you won't contaminate the finish in the can by transferring dust from the workpiece.

CONDITION BRISTLES. To make it easier to clean up the brush after use, I make it a point to "condition" the bristles. This is just a matter of dipping the bristles into the appropriate thinner (mineral spirits for varnish, water for water-based finishes, and alcohol for shellac), see photo C.

LOAD BRUSH. Even something as simple as "loading" the brush can affect the finish. To avoid runs, dip the bristles about halfway into the finish. Then press them against the sides of the container to remove the excess finish, see photo D. This works better than dragging the bristles across the edge of the container which can create air bubbles in the finish.



C. Condition Bristles. To condition the brush, dip the bristles into a thinner and then remove the excess.

D. Load Brush. After dipping the bristles in the finish, press them against the side of the container.

Brushes — A Basic Set

All it takes to handle most finishing jobs is a basic set of brushes. Although you don't need a lot of them, it's worth buying good quality brushes. With proper care and cleaning, they should last indefinitely.

CHISEL-EDGE BRUSH. The brush I reach for most often is a 2"-wide, *chisel-edge brush* with natural bristles, see photo at upper right. This one is a badger bristle brush that cost about $23 at a local woodworking store.

SASH BRUSH. But there are times when I need to apply a precise, controlled line of finish. That's when the angled bristles on this 1½"-wide *sash brush* come in handy. This brush has synthetic bristles (for water-based finishes). It cost about $12 at the home center.

ARTIST'S BRUSH. One of my favorite brushes for applying a finish to ornate or complex surfaces is this 1½"-wide *artist's brush*, see photo at right. The synthetic bristles on this brush create a knife-like edge that provides sharp control. Note: This brush (manufactured by Windsor and Newton) is available for about $30 from many art stores and the mail-order source on page 31.

OVAL BRUSH. I also use this 1" *oval brush* frequently, see photo at right. It's thicker than a standard rectangular brush, so it holds more finish. This makes it ideal as a "dry" brush to mop up excess finish, refer to pages 28 and 29. Note: I bought the oval brush for $6 at a home center.

Brushing on a Finish

Selecting a quality brush is half the battle when it comes to applying a finish. But getting a smooth, even finish depends on how you *use* the brush when applying a finish. Depending on the type of surface, I use several different techniques.

HORIZONTAL SURFACES

It's easiest to apply a finish to a flat, horizontal surface like the top of a table or a shelf. But even so, there are a couple of things you'll want to keep in mind.

To prevent the finish from dripping off the edge of the surface, place the brush a few inches in from the edge of the workpiece, see Step 1 above. Then just "sweep" the finish lightly off the edge.

Applying finish to the rest of the surface is just a matter of going back to the starting point. Then after overlapping the wet finish by an inch or two, brush the finish back across the surface. Here again, sweep the brush off the opposite edge in a smooth motion, see Step 2 at top right.

VERTICAL SURFACES

If you're finishing a vertical surface like the side of a cabinet, things can get a little more challenging. That's because the finish tends to run down the surface as soon as you start brushing it on. To avoid this, I change my technique just a bit.

Start by loading the brush with *less* finish than normal (about half the amount of finish). This will help you avoid any big runs and drips. Then, instead of applying the finish up and down, brush *across* the surface, see Step 1 above. Here again, you'll want to start a couple of inches in and work the brush off the edge of the surface before working back to the opposite edge.

TIP OFF. Once the finish is applied to the entire surface, all that's necessary to smooth out any small runs or drips is to "tip off" the finish. To do this, start by pressing the excess finish in the bristles into the container of finish. Then with the brush held almost perpendicular to the surface, lightly drag the tips of the bristles from the bottom to the top of the workpiece, see Step 2 above.

INSIDE CORNERS

But not every project has simple, flat surfaces. It's the details, like the inside corners on a raised panel, that can make applying a finish a little more trying.

To avoid "working yourself into a corner," it's best to start at an inside corner and work your way out. On a raised panel, that means starting

Finishing Horizontal Surfaces

1 *Avoid drips and runs by starting a few inches in and brushing the finish off the edge.*

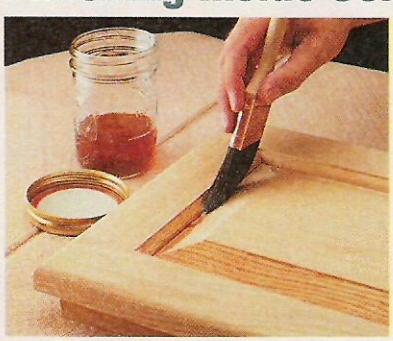
2 *To complete the pass, return to the starting point and brush the finish off the opposite edge.*

Finishing Vertical Surfaces

1 *To keep finish from running down a vertical surface, brush the finish across the surface first.*

2 *Then smooth out the finish by tipping off vertically, working from the bottom to the top.*

Finishing Inside Corners



1 *For inside corners, it's best to apply the finish by working from the corner out.*

2 *Remove the excess finish from the corners by dabbing it up with a dry brush.*

where the panel meets the rails and stiles, see Step 1 at bottom of page 28.

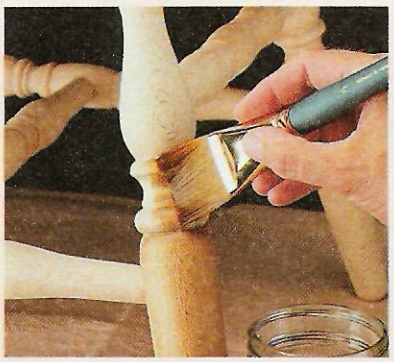
Because it can be difficult to start smoothly in a corner, the finish can "puddle" along the joint line or in one of the corners. To remove the excess, I like to keep a small dry brush handy. Dabbing the brush into the excess finish before it has a chance to set up will "wick" the finish up into the brush, see Step 2 on bottom of page 28.

SPINDLES

When it comes to a spindle that's been turned on the lathe (like the legs on a chair), applying a finish is a real challenge. Brushing up and down the spindle will cause the finish to run. That's because details turned into the spindle (like coves and beads) catch on the bristles and "pull" too much finish out.

To avoid this, I apply the finish by brushing *around* the workpiece, see Step 1 at right. Here again, you might notice a little excess finish in the details of the spindle. A little work with a dry brush will pick up the excess and leave a crisply finished detail, see Step 2.

Finishing Spindles



1 *To avoid runs and drips on a spindle, apply the finish in a circular motion around the spindle.*

2 *Here again, remove any finish that "pools" up by wicking it up with a dry brush.*

MAINTAINING A BRUSH

Once you're done applying finish to the project, it's well worth spending a few minutes time to clean up your brush. This way, you can make sure it stays in as good a shape as the day you bought it.

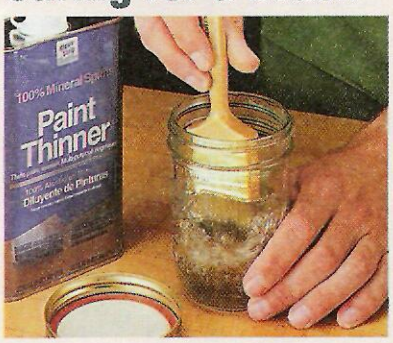
RINSE WITH THINNER. After wiping the excess finish out of the brush on a scrap piece, rinse out any additional finish using the appropriate thinner, see Step 1 below. You may have to rinse the brush in fresh thinner a few times to remove most of the finish. Once that's complete, wrap the brush in a rag or paper towel to soak up the thinner.

WASH. After you've removed as much thinner as possible, squirt a few drops of dishwashing detergent into the bristles of the brush. Then work up a lather by swirling the bristles around in the palm of your hand, see Step 2. Here again, you may need to repeat this process a couple of times until the brush no longer feels slimy.

SPIN OUT WATER. After rinsing the brush thoroughly in water to remove all the soap, lower the brush into an empty bucket. Then spin the brush in the palms of your hands, see Step 3. This removes the excess water from the bristles of the brush like a dog shaking off bath water.

COMB & STORE. All the washing and spinning may leave the bristles of the brush looking a little ragged. So I use a brush comb to straighten out the bristles, see Step 4. Then to make sure the bristles hold their shape while they dry, wrap the brush in a paper towel and set it aside to dry.

Caring for a Brush



1 *Rinse the brush thoroughly in the appropriate thinner to remove any excess finish.*

2 *Then use a squirt of detergent and work up a lather to remove the thinner and any remaining finish.*

3 *To remove the excess rinse water, simply spin the handle of the brush between your palms.*

4 *Finally, straighten the bristles with a comb, wrap the brush in a paper towel, and lay it flat to dry.*

Tool Talk

TOOLS OF THE TRADE

Jacobs *PowerCollet*

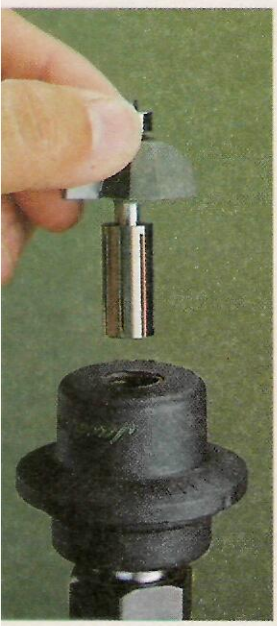
■ Change a router bit without fiddling around with wrenches? I was intrigued. This new collet (called a *PowerCollet*) tightens and loosens using *hand pressure* only — yet it holds bits securely.

At least that's what I'd heard. But would a "no-wrench" collet hold a bit tightly enough to keep it from slipping? To find out, I decided to buy one and give it a try.

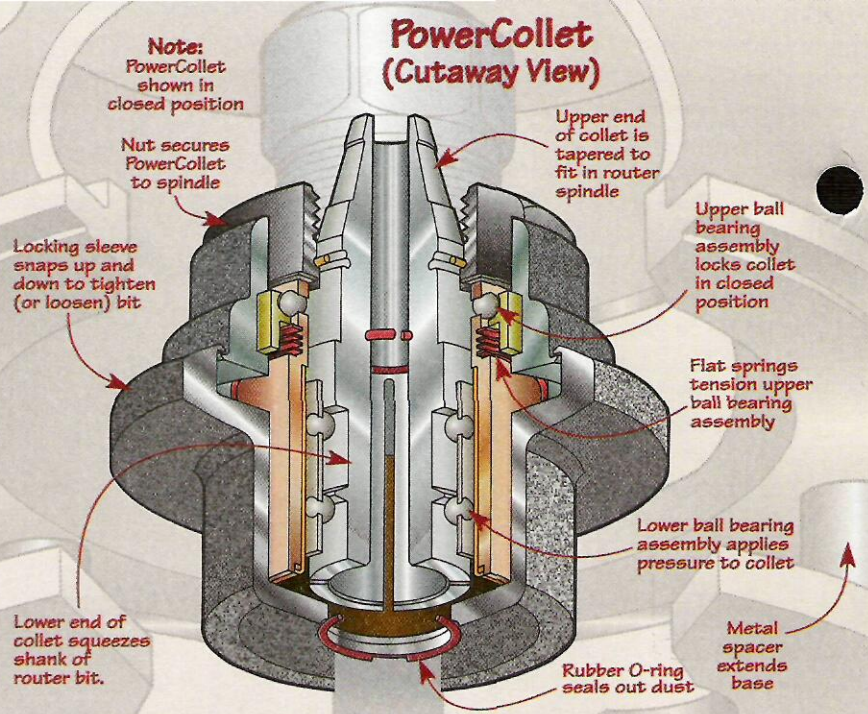
The collet I bought fits a Porter Cable router. But collets are also available for a number of other routers. Note: The *PowerCollet* is manufactured by the Jacobs Chuck Company, and it sells for about $45. (For Sources, see page 31.)

MOUNT COLLET. It took just a minute to remove my original collet and tighten the *PowerCollet* on the spindle, see drawing above. But the *PowerCollet* is a little bulky. So to accommodate it, I had to install three metal spacers to extend the base of the router. (The spacers are provided.)

LOCKING SLEEVE. With the collet in place, it's easy to see how it works. There's a *locking sleeve* that snaps up and down to tighten (or loosen) a router bit. Note: I found it easiest to remove the router base when changing bits.



▲ *To adapt the 1/2" collet to a router bit with a 1/4" shank, slip a sleeve (included with the collet) onto the bit.*


PowerCollet
(Cutaway View)
Note: PowerCollet shown in closed position
Nut secures PowerCollet to spindle
Upper end of collet is tapered to fit in router spindle
Upper ball bearing assembly locks collet in closed position
Locking sleeve snaps up and down to tighten (or loosen) bit
Flat springs tension upper ball bearing assembly
Lower ball bearing assembly applies pressure to collet
Lower end of collet squeezes shank of router bit.
Metal spacer extends base
Rubber O-ring seals out dust

When you snap the sleeve *away* from the body of the router, the collet is in the "open" position, see Fig. 1 below. To do this, place your thumbs under the sleeve and give it a firm push — the collet snaps open with a click.

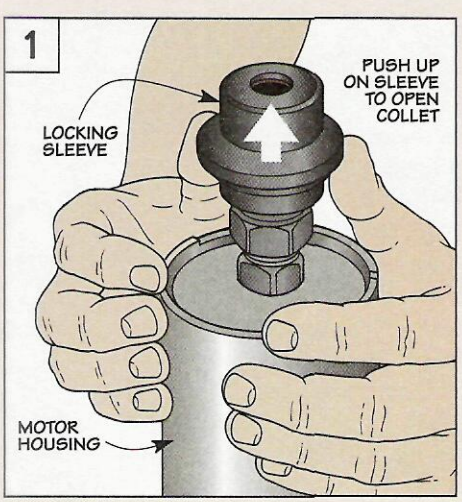
INSERT BIT. Now simply insert the bit in the collet, see Fig. 2. You'll feel some resistance here. That's because the bit has to slide through a rubber O-ring that seals dust out of the collet.

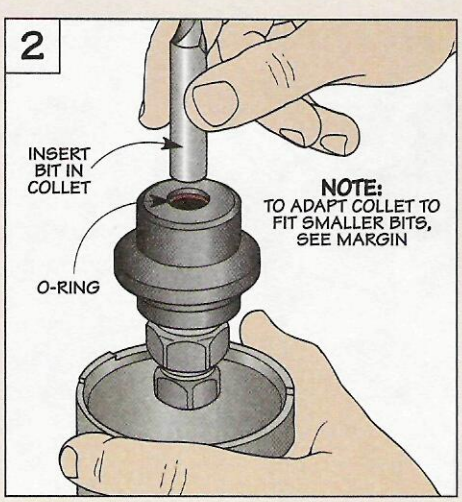
TIGHTEN COLLET. To tighten the collet around the bit, you have to snap the sleeve *toward* the router. This takes some getting used to. Not because it requires a lot of pressure. But because the pressure has to be applied *straight down* in a quick, firm motion. I got better leverage by placing the thick part of my hands on top of the sleeve, see Fig. 3.

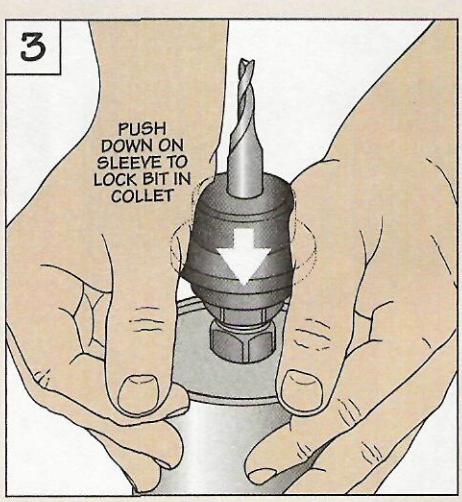
There's one thing worth mentioning here. If you leave the base of the router on (or you mount the router in a table), you'll have to press the sleeve down with your *fingertips*. That requires quite a bit of finger strength.

A TEST. Tightening the bit in the collet is one thing. But does it *stay* tight? By plowing deep grooves through hard maple, I got the answer I was hoping for. The collet held the bit tightly in place without any sign of slipping.

CONCLUSION. All in all, I was impressed by the *PowerCollet*. It makes changing bits fast, and it grips them tightly in place. I only have two quibbles. The sleeve is a bit stiff — and so is the price.



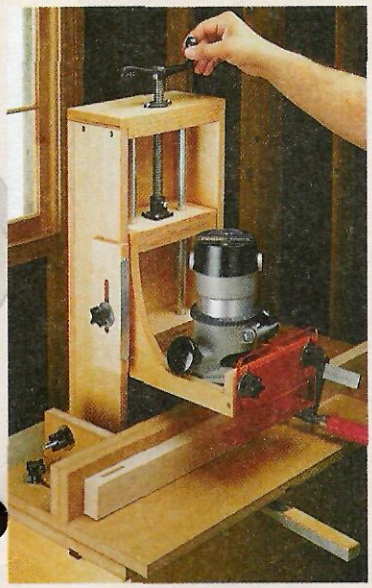




Sources

PRODUCT INFORMATION

ShopNotes Project Supplies *is offering some of the hardware and supplies needed to build the projects in this issue. We've also put together a list of other mail-order sources that have similar hardware and supplies.*

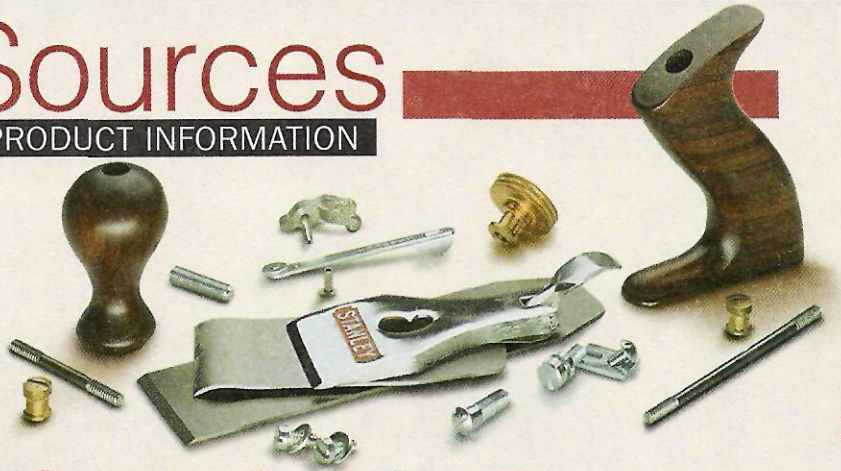


▲ Mortising Machine

The Mortising Machine featured on page 16 makes it easy to cut mortises quickly and accurately.

ShopNotes Project Supplies is offering a complete hardware kit to build the Mortising Machine. It includes everything you need to build this Mortising Machine with the exception of the hardwood, plywood, and Medium-Density Fiberboard (MDF).

MORTISING MACHINE KIT
6847-100.....$102.95

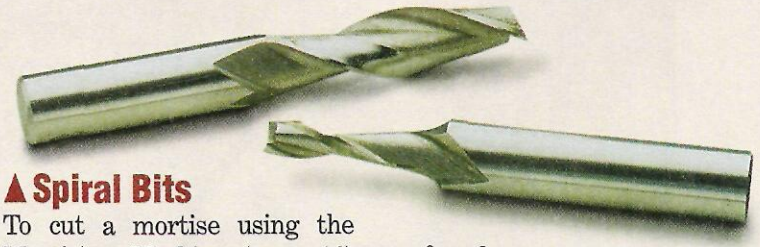


▲ Replacement Parts for Bench Planes

The article on page 10 explains how to restore a metal bench plane. If you're planning to turn an old, beat-up plane into a usable tool, you may find that some parts are either damaged or missing. Fortunately, most of these parts are still available. You can even get a handle and knob made from rosewood. (See margin for a source of parts.)

Jacobs *PowerCollet* ►

The Jacobs *PowerCollet* (page 30) lets you change router bits without using any wrenches. It fits the Bosch 1615, DeWalt 625, Makita 3612 and Porter Cable 690 and 7500 series routers. The *PowerCollet* accepts ½"-dia. shank bits. But a sleeve (included with the collet) lets you use ¼"-dia. shank bits as well, see margin for sources. For more information you can call 800-866-5753.



▲ Spiral Bits

To cut a mortise using the Mortising Machine (page 16), we found that these spiral upcut router bits produced a clean cut with little (if any) tearout. These bits are available in a number of sizes (including the ¼" and ½" bits shown here). To reduce vibration, we recommend using ½" shank bits. (See margin for mail-order sources.)

MAIL ORDER SOURCES

Eagle America
800-872-2511
Phenolic

Homestead Finishing Products
216-631-5309
Brushes

Klingspor
800-228-000
Sanding Blocks

Lee Valley & Veritas
800-871-8158
Brushes, Rare-Earth Magnets

Trend-Lines
800-767-9999
Jacobs PowerCollet

Woodcraft
800-225-1153
Bench Plane Parts, Jacobs PowerCollet, Rare-Earth Magnets, Spiral Router Bits,

Woodhaven
800-344-6657
Phenolic, Spiral Router Bits

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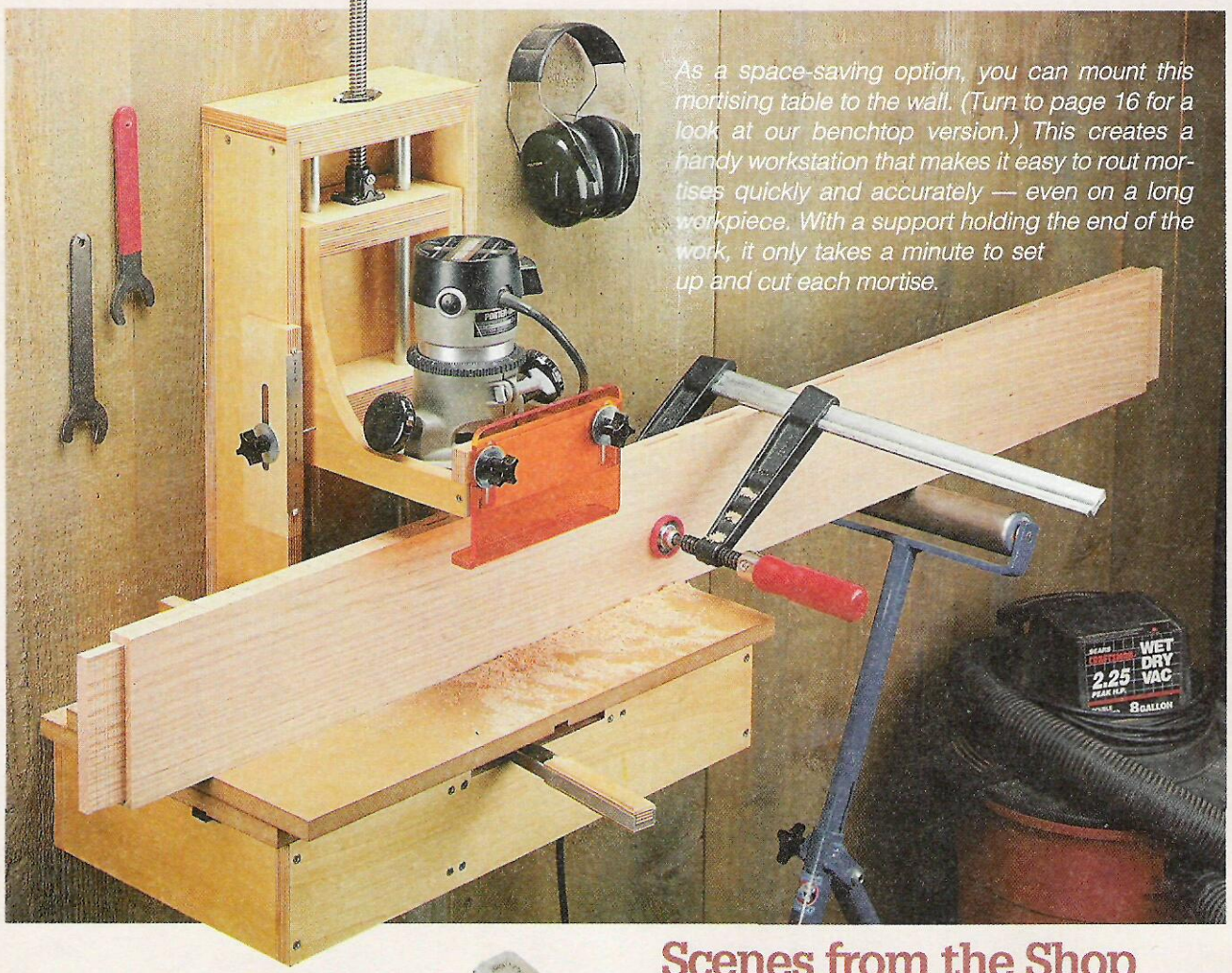
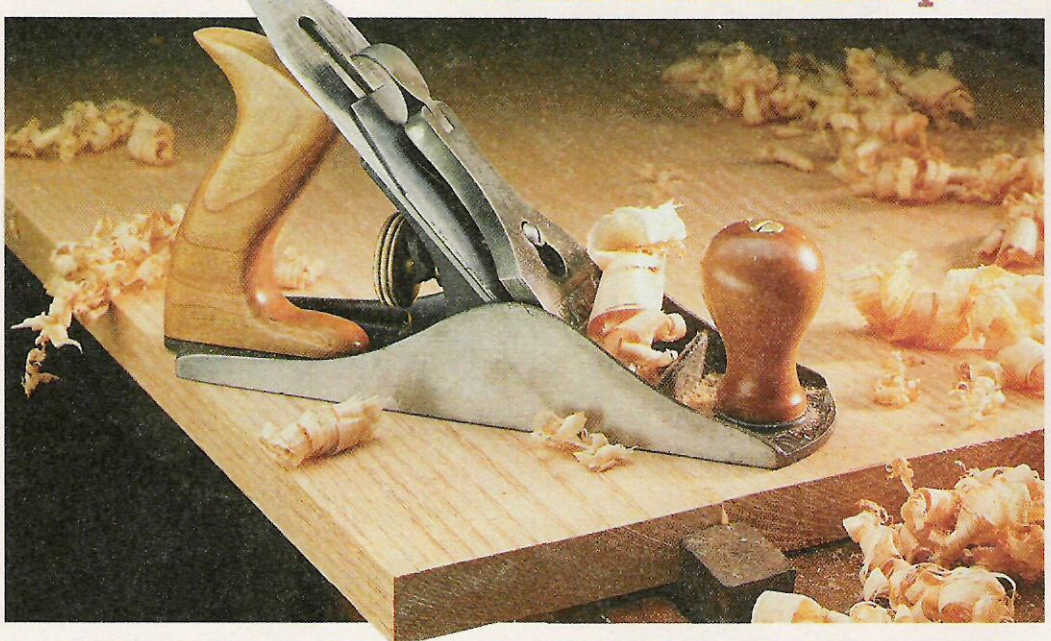


As a space-saving option, you can mount this mortising table to the wall. (Turn to page 16 for a look at our benchtop version.) This creates a handy workstation that makes it easy to rout mortises quickly and accurately — even on a long workpiece. With a support holding the end of the work, it only takes a minute to set up and cut each mortise.

Scenes from the Shop



Restoring an old hand plane to a usable condition? Here's a different twist. Instead of using rosewood, the replacement handle and front knob on this Stanley No. 4 bench plane are made of highly-figured cherry. (For more information on restoring a bench plane, turn to page 10.)